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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 Congress Street, Suite 1100
BOSTON, MA 02114-2023

Memorandum

Date: **September 9, 2005**

Subject: **Industri-plex OU-2: Woburn Conservation Commission Question**

From: **Joseph LeMay, RPM** JFL

To: **File/ IP OU-2 Administrative Record**

In July 2005, EPA received a telephone message from Ms. Theresa Murphy, Woburn Conservation Commission. Ms. Murphy understands that EPA has identified contamination in the Aberjona River, and asked the following question:

She was informed that a business in Woburn may be withdrawing surface water from the Aberjona River to presumably use in its commercial products such as hydro-seeding mixtures. If surface water were being withdrawn from the river, then what would EPA's position be on the matter, and does it violate any federal laws?

ASC

Aberjona Study Coalition, Inc
10 North Maple Street
Woburn MA 01801-1407
www.aberjonastudy.org

(781) 935-2438 ***email info@aberjonastudy.org***

INDUSTRI-PLEX
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SDMS DocID 237714

July 1, 2005

Mr. Joseph LeMay
Remedial Project Manager
U.S. EPA Region 1
1 Congress Street
Suite 1100 (HBO)
Boston, MA 02114-2003

Subject:
Draft Final MSGRP Remedial Investigation Report Industri-Plex Site/Wells G&H
Draft Final Feasibility Study:Remedial Investigation/Feasibility Study June 30 2005
Proposed Plan Industri-Plex Superfund Site Operable Unit 2 (including Wells G & H Operable Unit 3) Woburn, MA

Dear Mr. LeMay:

The Aberjona Study Coalition, Inc. is requesting an extension to the 30-day comment period for the Draft Final Feasibility Study: MSGRP Remedial Investigation/Feasibility Study issued on June 30, 2005 as well as the Proposed Plan listed above.

The Aberjona Study Coalition, Inc. was awarded a double Technical Assistant Grant from the EPA in the amount of $100,000. ASC is an organization of six community groups: Woburn Neighborhood Association, Inc., Mystic River Watershed Association, Friends of the Upper Mystic Lake, Concerned Citizens Network, Woburn Residents Environmental Network and Medford Boat Club representing over 225,000 residents who are affected by the Aberjona Watershed from the 7th Congressional District.

The EPA 30-day comment period from July 1, 2005 through August 1, 2005 is unacceptable. Speaking on behalf of the average person residing along the Aberjona River Watershed it is impossible to review and comment on 12 volumes: Industri-Plex Site Multiple Source Groundwater Response Plan Remedial Investigation Report Operable Unit 2 which contains 3,551 KB with links to 217 additional PDF files including the Draft Final Feasibility Study and Proposed Plan in 30 days which was just released on June 30, 2005 as listed on the EPA Website:
www.epa.gov/ne/superfund/sites/industriplex and
www.epa.gov/ne/superfund/sites/wellsgh

The Aberjona Study Coalition, Inc. in conjunction with our Technical Advisors from Cambridge Environmental, Inc. are requesting the extension to the comment period for the Draft Final Feasibility Study: Remedial Investigation/Feasibility Study as well as the Proposed Plan released on June 30, 2005 be extended through October 1, 2005.

Sincerely,

Linda A. Raymond

Linda A. Raymond, Treasurer
Aberjona Study Coalition, Inc.

Cc:
Congressman Edward J. Markey
State Representative Patrick M. Natale
Woburn City Council
Woburn Mayor John Curran

Linda A Raymond Treasurer
Aberjona Study Coalition, Inc.
10 North Maple Street
Woburn MA 01801

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USA

Mr. Joseph LeMay
Remedial Project Manager
U.S. EPA Region 1
1 Congress Street
Suite 1100 (HBO)
Boston, MA 02114-2003

02114-2010

Fennelly/Taylor
<fennellytaylor@sprintmail.com>

07/11/2005 05:19 PM

To Joe Lemay/R1/USEPA/US@EPA

cc

bcc

Subject Woburn Superfund site, possibility for fill

Winter Pond in Winchester, near the Woburn line, has long been a recommendation for dredging. If this EPA project (or others) needs some certified 'good dirt', Winter Pond has it.
The Pond belongs to the State, under the Town's jurisdiction. Town Manager would be contact person.

Hope this may be useful to you. Thanks.

Susan Fennelly, Friends of Winter Pond

Industri-Plex
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The Commonwealth of Massachusetts
House of Representatives
State House, Boston 02133-1020

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PATRICK M. NATALE
REPRESENTATIVE
THIRTIETH MIDDLESEX DISTRICT
WOBURN - READING - STONEHAM

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Committees:
Election Laws
Children and Families
Telecommunications, Utilities & Energy

SDMS DocID 237715

July 14, 2005

Mr. Joseph LeMay
Remedial Project Manager
U.S. Region 1
1 Congress Street
Suite 110 (HBO)
Boston, MA 02114-2003

Dear Mr. LeMay:

I'm writing in support of a request to extend the deadline for the Final Draft Feasibility Study. Because of the complexity of this study, the original deadline does not provide sufficient time to complete the final draft in its entirety

The Aberjona Study Coalition, Inc. in conjunction with the Technical Advisors from Cambridge Environmental, Inc. are requesting an extension to the comment period for the Draft Final Feasibility Study: **Remedial Investigation/Feasibility Study as well as the Proposed Plan release on June 30, 2005 be extended through October 1, 2005.**

Sincerely,

Patrick Natale, Esq., LL.M
State Representative
30th Middlesex District
Woburn, Reading, Stoneham

cc: Linda A. Raymond, Treasurer,
Aberjona Study Coalition, Inc.

The Commonwealth of Massachusetts
House of Representatives
State House, Boston 02133-1020

PATRICK M. NATALE
STATE REPRESENTATIVE
30TH MIDDLESEX DISTRICT

HBO ✓

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Mr. Joseph LeMay
Remedial Project Manager
U.S. Region 1
1 Congress Street
Suite 110 (HBO)
Boston, MA 02114-2003

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SDMS DocID 237718

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BOSTON NEW YORK PALO ALTO SAN FRANCISCO WASHINGTON, DC www.ropesgray.com

July 18, 2005

Paul B. Galvani
(617) 951-7543
paul.galvani@ropesgray.com

BY ELECTRONIC MAIL AND HAND DELIVERY

Joseph F. LeMay
Remedial Project Manager
US EPA—New England
One Congress Street, Suite 1100 (HBO)
Boston, MA 02114-2023

Re: Request for Extension of Time to Respond to MSGRP RI and FS for Industriplex Site

Dear Mr. LeMay:

I am writing on behalf of my client, Stauffer Management Company LLC ("SMC") to request an extension of time to respond to the EPA's Multiple Source Groundwater Response Plan Remedial Investigation ("MSGRP RI") report and Feasibility Study ("FS") for the Industriplex Site (the "Site") in Woburn, Massachusetts. According to the Proposed Plan promulgated by EPA in June 2005, comments to the MSGRP RI and FS currently are due on August 1, 2005.

SMC hereby requests an extension of time for at least 120 days, until December 1, 2005, to respond to the MSGRP RI and FS. There are several reasons for this request. First, the volume of materials to be digested by SMC and its experts before commenting on these documents is substantial: the MSGRP RI is 423 pages long and the FS is 243 pages long, not including exhibits and appendices. The administrative record underlying these documents takes up five CDs worth of materials. In light of the fact that SMC is required to comment simultaneously on *both* the MSGRP RI and the FS, and in light of the sheer volume of materials to be reviewed, SMC requires far more than 30 days to provide meaningful comment.

Second, review of the materials recently released by EPA will require SMC to gather experts from multiple disciplines in order to comprehend thoroughly EPA's findings. Thus, SMC will need the assistance of experts on topics including, but not limited to, contaminant fate and transport, ecological risk assessment, human risk assessment, and engineering. It will take time for SMC to coordinate with its experts in order to gather feedback on all aspects of the reports, and to condense such feedback into a useful and comprehensible set of comments.

Third, you indicated at the public hearing on EPA's Proposed Plan in Woburn on June 30, 2005, that EPA considered over 70 different ideas for cleanup of the Site, which were narrowed down to 27 options identified in the FS, which were further narrowed to the multi-faceted approach endorsed by EPA in the Proposed Plan. SMC will need to assess some, if not all, of the ideas considered but rejected by EPA, in order to assess EPA's decision-making. Consideration of so many different possibilities will take time, certainly more than the one month that is currently provided.

Fourth, in light of the fact that it has taken EPA several years to complete these reports, it is grossly prejudicial to require SMC and other interested parties to provide comments on these reports within 30 days. SMC requires, at a minimum, an extension of 120 days to offer EPA feedback on these voluminous reports, which have taken EPA years to compile.

Finally, it is worth noting that SMC is not the only party that will be requesting additional time to respond to the MSGRP RI and FS. At the June 30 public hearing, several individuals indicated that they would be seeking additional time, on behalf of municipalities or other interested parties, in which to comment. The interested parties appear to be on the same page in suggesting to EPA that much more time is needed before meaningful comments on these reports can be provided to EPA.

In light of the foregoing, SMC believes that an extension of at least 120 days (through December 1, 2005) to comment on the MSGRP RI and FS is necessary to provide EPA with thorough, comprehensive feedback on these very important reports. Please do not hesitate to contact me if you have any questions regarding this request. Thank you for your consideration.

Very truly yours,

Paul B. Galvani

Paul B. Galvani

cc: John D. Beling, Esq. (by hand delivery only)
Luke W. Mette, Esq.

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ONE INTERNATIONAL PLACE
BOSTON, MA 02110-2624

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Mail Room

ROPES & GRAY

ROPES & GRAY LLP
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FILE | INITIALS

Joseph F. LeMay
Remedial Project Manager
US EPA – New England
One Congress Street, Suite 1100 (HBO)
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LUCY ELANDJIAN *
ANNE-MARIE H. GERBER +

KATHLEEN GROVER ▿
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* OF COUNSEL
♮ INTERNATIONAL COUNSEL

UNLESS DESIGNATED OTHERWISE, OUR ATTORNEYS ARE ADMITTED ONLY IN MASSACHUSETTS

+ ALSO ADMITTED IN CALIFORNIA
▵ ALSO ADMITTED IN CONNECTICUT
▿ ONLY ADMITTED IN CONNECTICUT
• ALSO ADMITTED IN NEW YORK
§ ONLY ADMITTED IN VERMONT
† ALSO ADMITTED IN NEW HAMPSHIRE
○ ONLY ADMITTED IN RHODE ISLAND
◇ ALSO ADMITTED IN RHODE ISLAND
▴ ONLY ADMITTED IN WASHINGTON, D.C.
◆ ONLY ADMITTED IN MARYLAND

July 19, 2005

BY HAND DELIVERY

Mr. John Beling, Esq.
Assistant Regional Counsel
United States Environmental Protection Agency
Region 1
1 Congress Street, Suite 1100
Boston, MA 02114-2023

Re: Request For Extension in Time to Comment on U.S. Environmental Protection Agency's "Draft Final Feasibility Study, Remedial Investigation/Feasibility Study, Industri-Plex Site, Woburn, Massachusetts," June 2005, "Proposed Plan Administrative Record," June 2005, and "Draft Final MSGRP Remedial Investigation Report," March 2005.

Dear Attorney Beling:

On behalf of Pharmacia Corporation (formerly known as Monsanto Company), Monsanto Company ("New Monsanto") hereby requests an extension in time to at least December 1, 2005 to comment or otherwise respond to the U.S. Environmental Protection Agency's June 2005 "Draft Final Feasibility Study, Remedial Investigation/Feasibility Study, Industri-Plex Site, Woburn, Massachusetts," (the FS), the "Proposed Plan Administrative Record," and the March 2005 "Draft Final MSGRP Remedial Investigation Report." These documents comprise the current record for U.S. EPA's "Proposed Cleanup Plan for the Industri-Plex Superfund Site, Operable Unit-2 and Wells G & H Superfund Site, Operable Unit 3, Aberjona River Study, Woburn, Massachusetts and the Comprehensive Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation (RI)."

On April 28, 2005, during a public information session, the U.S. EPA advised the public it would have an opportunity to comment on the Draft Final MSGRP Remedial Investigation Report contemporaneously with the FS. At the June 30, 2005 public information meeting conducted by the U.S. EPA , the public was informed that comments on both documents were due August 1, 2005 even though the documents were only released on that date. On July 18, 2005, the U.S. EPA extended the due date to August 30, 2005.

While the EPA has taken years to compile data from numerous reports, New Monsanto is in a position of having to properly evaluate this same data in a relatively truncated period of time. Furthermore, the EPA's proposed remedy is estimated to cost $25.7 million, which is a very significant amount of money. Respectfully, a two month comment period is simply insufficient to allow New Monsanto to effectively comment on the EPA's draft final comprehensive reports. I have received a total of 5 disks of information from Mr. LeMay to date, spanning over 20 years and evaluating alternatives for the site and a proposed plan. The extension in time through the summer and fall months will allow New Monsanto sufficient time to review this data and retain experts—and accommodate their summer vacation schedules—and to task them to review the government's reports and comment on the proposed plan in a meaningful manner. Preliminary reports indicate that the review of the record alone will proceed through September. Thereafter, the experts will need time to comment on the reports.

You have stated that you are aware of the public's concern that they have adequate time to digest and comment on the recent reports. The extension requested is reasonable in light of the voluminous record and the complexity of the analyses that the experts will have to undertake.

Finally, New Monsanto, on behalf of Pharmacia Corporation, is not the only member of the public wishing to comment on the government's proposed plan. We hope the extension in time also will allow an opportunity for New Monsanto to review the comments of others and incorporate their contributions where appropriate.

In light of the foregoing, please let me know at your earliest convenience what action you will take on this extension request so that New Monsanto can plan accordingly.

Very truly yours,

William L. Parker

William L. Parker

cc: Mary M. Shaffer, Esq.
Carol A. Casazza, Esq.
Peter Virden
Gerald Rinaldi
Joseph F. LeMay

FITZHUGH, PARKER & ALVARO LLP
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Joe LeMay
Enforcement Counsel
US Environmental Protection Agency
1 Congress Street, Suite 1100
Boston, MA 02114-2023

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City of Woburn, Massachusetts

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OFFICE OF THE CITY CLERK

City Hall
10 Common Street
Woburn, MA 01801
781-932-4450

WILLIAM C. CAMPBELL
City Clerk

July 21, 2005

Robert W. Varney, Regional Administrator
U.S. EPA Region 1
One Congress Street – Suite 1100
Boston, MA 02114-2023

Re: Proposed Cleanup Plan for the Industri-plex OU 2 Superfund Site
(and including Wells G&H OU 3)

Dear Mr. Varney:

At its Regular Meeting on July 19, 2005, the City Council of the City of Woburn voted to request that the United States Environmental Protection Agency extend the comment period for the Proposed Cleanup Plan for the Industri-plex OU 2 Superfund Site (and including Wells G&H OU 3) for an additional ninety (90) days as the city has been having difficulty obtaining funding for the review and in addition the city is at this time soliciting independent peer review in addition to the TOSC review as this proposed plan establishes a significant precedent, model, or methodology, addresses significant controversial issues, involves significant investment of Agency resources, and considers an innovative approach for a previously defined problem/process/methodology.

Thank you for your attention to this matter.

Very truly yours,
WOBURN CITY COUNCIL

By: [signature]
William C. Campbell, City Clerk

cc: Senator Edward M. Kennedy
Senator John F. Kerry
Representative Edward J. Markey
State Senator Robert A. Havern
State Representative Jay R. Kaufman
State Representative Patrick Natale

July 26, 2005

Mr. Joseph LeMay
US EPA
1 Congress Street, Suite 1100 (HB0)
Boston, MA 02114-2023

FAX 617-918-1291

Dear Mr. LeMay (lemay.joseph@epa.gov):

RE: INDUSTRI-PLEX SITE (Operable Unit 2)
WELLS G & H (Operable Unit 3), WOBURN, MA
Remedial Investigation/Feasibility Study **MSGRP**
(Multiple Source Ground Water Response Plan)
Halls Brook Holding Area (HBHA)/Aberjona River – to Mystic Lakes extending…

I give a huge amount of credit to the manpower, hydrology **, and expense that has been put into the report. I, therefore, would positively like to add the following checks and balances:

The old "capping" scenario that was completed at these Superfund sites was obviously not the "best (or only) solution" and in fact development & capping may have hindered the ability to perform ground water and environmental protection to receptors spread further from sources over the years as evidenced in this report. The consequences are far reaching both physically and financially; and time can be the essence.

- I agree with the "concept" of the report. However, the intended action (noted as **"permanent" for MSGRP**) for intervention **is not sufficient** for "a permanent solution".
- In some instances the HEALTH RISK ASSESSMENTS are based only on food and does not include the breathing, drinking water, and skin absorption of receptors to contamination sources (life's necessities).
- Contamination has had quality of life health implications. Wildlife is dead and yet you find no reason ("no link"); only that you will replace life for the area to hopefully thrive once again.
- GW-1 (drinking water source areas) must be given the highest priority for clean-up. Better intervention is needed and should be updated for GW-1 to **include only the newest and best technology available to identify and address the**

**Encyclopedia Americana – Library of Congress #64-12146

- **"actual break-down products and risks (contaminants) imposed (forced on our environment) by the PRPs'** at possibly GW-2 or GW-3 locations if not at the source, or holding areas. Applying newer technologies along with "treatment trains" will further enhance removal.

- While Olin is mentioned, your report does not **include source discharges to Halls Brook from Olin Chemical Industry/Wilmington under EPA NPDES permits**. Olin & the South Wilmington industrial area previously had an old septic ditch system: East Ditch, South Ditch, and West Ditch, etc.

- Are there any other NPDES discharge permits to Halls Brook or the Study Area not mentioned? If so, please incorporate.

- Local & state officials" have finally followed residents' guidance that Olin Chemical Industry should have been better addressed; and that they be listed in the "federal Superfund program, since the feds have access to the best technologies & can apply additional law & oversight above, beyond, and in conjunction with the State due to impacts to the river system(s). The Governor's response is pending.

Despite aeration-carbon-GAC filtration system at our Butters Row Treatment Plant, Olin was responsible for contaminating our aquifer, the temporary closing of Wilmington's town drinking water wells located to the west of their property including impacts to your superfund projects (horizontal/vertical/lateral), from ground, to surface, water, and to depth.

Olin representatives have publicly stated that the most pertinent identified metal for their concern was **"chromium" in the area of billions of gallons** discharged into the ground from the production of "sodium dichromate" (which is hexavalent chrome). Mercury, a never ending fate of exposure we all face in testing is masked by hexamine (only closest to the source?). Hexamine was one of the first EPA reported contaminants breakdown products to monitor; then phenols, and phthalates during Wells G&H-Olin study. High production volume holding tanks were part of the chemical industrial processes.

Intentionally or unintentionally, the "required" (or regulated) EPA NPDES testing for Olin does not fully protect public health or the environment through responsible testing and control and your report follows the same path without considering what is actually there; or the actual site conditions..

The named chemical of concern to health in Wilmington's drinking water, while unregulated, is NDMA (N-nitrosodimethylamine); and there is never just one chemical (hydrocarbon) of concern at any of these sites.

- The **most up-to-date technology should be made available** and used to be most protective of public health and the environment where there is a complete exposure pathway; if you'd like, I can give you the names of the testing equipment that the Lawrence Wall Station had requested for Massachusetts to be ready in the event of terrorism after 9/11, and so we could be most protective of human health with better testing. Considering you have access to the top scientists and engineers, I will assume you know what this equipment would entail.

- We know that the **hydrocarbon cycle**** must be considered. Our experience in Wilmington is that the **nitrogen cycle** too plays a role (**and so on...**) in important testing down to ppt (parts per trillion/medicinal) to be most protective, and there can be a co-mingling effect.

- Massachusetts is a technology state; and here lie the resources to restore the waters of the United States.

- I had hoped that EPA would be FORCING only the newest technologies and ideas with our industries PRP's (potentially responsible parties) towards the mutual goal & understanding that priceless healthy communities bring priceless healthy economies, and priceless healthy technology brings growth on all fronts.

I remain optimistic. We learn through our trials and tributes, and hopefully from our mistakes – we can then get better (God's reason?).

While many people have many ideas "agendas", the one I feel may be most important is the "state of environmental health". It ties in most vital to human health, universal human rights, our economy, & priceless life & land of the free (USA); and in everyway is worth fighting for given the "big picture.

They say trickle down; I say trickle up. Take care of the little guy with a "universal moral-human rights view" and it will trickle up to the big guy (the powerful).

- Through Toxic Use Reduction, we have come to find that **reducing the "volume" of chemicals** in a single area is **the most productive** towards restoring the larger picture. **Condensing or concentrating contamination has negative consequences that must be considered.**

- I understand that Wells G&H remain a drinking water source area although temporarily closed, scored as "moderate-low" ability to be productive; and that alone should keep the area high priority as impacted from the PRPs.

- While Woburn relies partially on MWRA for public water supply (which is over the health standard for lead through distribution), it is my understanding that Woburn continues to pull from its own resources. Where exactly are Woburn's current town drinking-water sources in relation to this study area? Is there any possible impact; and has the best technology from these contaminants been employed beyond the drinking water standards for the actual risks?

- Where in the report is your listing of any and all private wells? Have receptors within 500' (or other required footage) been notified and updated on the conditions to the best of our taxpayer knowledge? If not notified, they should be within the impacted radius and assisted as part of the process.

- ...Drinking water standards (complete receptor pathway) is regulated only item by item; and Release of complete hydrocarbons unregulated in Canada & the USA should be monitored at these sites as they pose human health risks associated with these sites.

- Risk Assessments "markers" (the metals) and not on full risks based on current technology available to better identify & quantify these risks; and were not used.

Hydrocarbons** from these sites have not been fully characterized where it reaches complete exposure pathways, nor metals or pesticides protective of public health through circumstances created by the PRPs.

Saturated/Unsaturated cycles are very important to consider, and the information is well-known.

In reference to the goal, we are benefited in that the water can be "contained" & hence the fate of contaminated media can be "controlled"; your report gives examples.

- Migration of contaminants is the same in the human body as it is in the environment; and billions of dollars have been put into the human health studies (transport & fate in the body) and should be applied environmentally, so - not be financially redundant with possible remedies prior to reaching life receptors.

Today we have Biotechnology, stem cell research, acid rain, and ozone issues altering RNA & DNA.

Altering the positions of CHNO2, etc. is what these companies do; (they'll thrive on technology)!

I'd much rather see a humane approach to eliminating the problems **BEFORE** it reaches the public (human beings, aquatic life, food chain, and biota). We can't ignore fate.

Sincerely,

Deborah L. Duggan

Deborah L. Duggan (978)657-7127
11 Hillcrest Street
Wilmington, MA 01887

Cc Governor Mitt Romney; State Rep. James Miceli; Selectwoman Suzanne Sullivan

**Encyclopedia Americana – Library of Congress #64-12146

Site: Industri-plex
Break: 4.1
Other: 237181

Send us Your Comments

You may use the form below to provide EPA with your written comments about the proposed plan for the Industri-plex Superfund Site Operable Unit 2 (including Wells G&H Operable Unit 3). Please mail this form and any additional written comments, postmarked no later than August 1, 2005 to:

SDMS DocID 237181

Joseph F. LeMay

U.S. EPA

1 Congress St., Suite 1100 (HBO)

Boston MA 02114

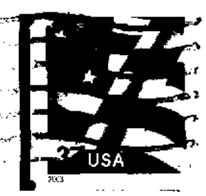
fax: 617-918-1291

e-mail: lemay.joseph@epa.gov

Who will be responsible if my land gets contaminated when you do this work

Comments Submitted by: ABERJONA Realty Corp (attach additional sheets as needed) public comment sheet (continued)

Fold, staple, stamp, and mail



J.C.W.
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Mr. Joseph F. LeMay
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RACI-EPA-5753

Contract No. 68-W6-0045

September 8, 2005

Mr. Joseph LeMay, P.E.
U.S. Environmental Protection Agency
1 Congress Street
Suite 1100 (HBO)
Boston, Massachusetts 02114-2203

Subject: Transmittal of July 27, 2005 Public Hearing Transcript
Industri-plex Site, Remedial Investigation/Feasibility Study
RAC I W.A. No. 116-RICO-0107

Dear Mr. LeMay:

Tetra Tech NUS, Inc. (TtNUS) is providing to you the transcript of the Public Hearing held on July 27, 2005 for the Industri-plex Site, Operable Unit 2 (Including Wells G&H Superfund Site Operable Unit 3) Proposed Plan. This submittal also contains an electronic disk of the transcript.

If you should have any questions, please contact me at 978-658-7899.

Very truly yours,

Gordon H. Bullard
Project Manager

PMO - 0

GHB/rp

Enclosures

c: H. Horahan (EPA) w/o enc.
G. Gardner/A. Ostrofsky (TtNUS) w/o enc.
File GN4123-3.4 w/enc./GN4123-1.0 w/o enc.

O'BRIEN & LEVINE

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In the matter of:

Industri-Plex Superfund Site Operable Unit 2 (Including Wells G&H Superfund Site Operable Unit 3) Proposed Plan Public Hearing

July 27, 2005

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Valerie R. Johnston 1-15681

INDUSTRI-PLEX SUPERFUND SITE

OPERABLE UNIT 2

(INCLUDING WELLS G&H SUPERFUND SITE

OPERABLE UNIT 3)

PROPOSED PLAN PUBLIC HEARING

WEDNESDAY, JULY 27, 2005

7:00 p.m.

P R O C E E D I N G S

MS. BONARRIGO: We're going to get started folks. Thanks for joining us tonight. It's good to see another great turnout.

My name is Angela Bonarrigo. I'm the committee outreach coordinator for the site, and tonight is, of course, the public hearing on the proposed plan for the Industri-plex Site.

Our agenda tonight is we will do a brief overview of the proposed plan. I see a lot of familiar faces from the meeting in June, but we thought for those that may not have been at that meeting and just as a refresher for everybody, a very brief overview, which Joe will spend some time on, and then we'll open up the formal hearing.

And Bob Cianciarulo, the Section Chief of Massachusetts sites will be our hearing officer. He'll take you through the process and the ground rules for the hearing.

I just want to take a moment to remind you that we are only listening during the hearing portion of tonight's meeting. We are not responding to any comments or questions that are raised. We are required to make those responses in writing at the close of the comment period.

I also just want to remind you that, if you'd like to make a comment this evening, we want to have your name, affiliation, address for the record. So I'll ask you to fill out an index card and hand that back to me.

So you may not have decided at this point, and you're welcome to make a decision later, but if anybody would like an index card at this time, I will be happy to give it to you.

Okay. I'm going to turn it over to Bob.

MR. CIANCIARULO: Thanks, Angela.

Good evening. My name is Bob Cianciarulo. I'm chief of the Massachusetts Superfund section of EPA's New England regional office. I'll be the hearing officer for tonight's hearing on the proposed remedy for the Industri-plex Superfund Site, Operable Unit 2 and the Wells G&H Superfund Site, Operable Unit 3, both sites located in Woburn.

The purpose of this hearing is to formally accept oral comments on the proposed plan, which was released to the public on June

30th, 2005.

As Angela mentioned, we will not be responding to comments tonight but will respond to them in writing sometime after the close of the comment period, which is August 31st.

This comment period was extended for 30 days in order to provide additional time for the public to review the feasibility study and proposed plan.

As you recall, the public information meeting on the plan was held on July 1st. At that meeting, information concerning the plan was presented, and the EPA responded to questions about the site.

Let me describe the format of the hearing that Angela just noted. First I'm going to have Joe LeMay, who's the EPA project manager for the site, give a brief overview of the proposed cleanup plan. Following that presentation, I will accept oral comments for the record.

As Angela mentioned, there are cards available. If you haven't filled out a card, you can do that with her. We'll then call on people to step to the microphone here, state your name, address and/or affiliation.

We have a stenographer here. She will be recording these proceedings verbatim, again, for the record.

I'm going to ask that you limit your comments to 10 minutes. If you think your comments are going to take longer than that, you might want to consider summarizing those comments and then provide us with a full text of the comment, which would -- which would also become part of the record.

After all the comments have been heard, I'll close the formal hearing, and again, if you wish to submit written comments, you can either hand those to us tonight or e-mail or fax or mail via U.S. mail. The details of those are on the proposed plan that you received. You can see any of us if you have any questions on how to submit comments.

All oral comments that we receive tonight and the written comments that we receive during the comment period will be addressed in what's called a Responsiveness Summary, and they will become part of the administrative record for the site and will be included in the decision on the remedy of the site.

Any questions as far as format? Anyone here? Okay.

Again, we're going to start with a brief overview of the plan. Joe LeMay.

MR. LeMAY: Thank you, Bob.

As you mentioned, my name is Joe LeMay. I am EPA's remedial project manager for the Industri-plex Superfund Site as well as the Wells G&H Superfund Site, and I'm here to present a brief overview of the proposed plan, which was explained in more detail on June 30th at a public information meeting here.

The overview is as follows: We released the proposed plan on June 30th, 2005. The public comment period that Bob mentioned was from July 1st through August 31st, 2005. Tonight is the public hearing, and we'll be having the Record of Decision with the Responsiveness Summary to the comments that we receive sometime in the fall of 2005.

In the proposed plan, we had presented

this figure, which is a summary of the proposed plan alternatives, and what we're going to do is go through each of the selected alternatives in the proposed plan.

First was Alternative GW-2, which is a pond intercept with monitoring and institutional controls that prevents or controls potential exposures to contaminated groundwater through institutional controls.

Coupled with Alternative HBHA-4, this alternative also controls the downstream migration of contaminated groundwater by intercepting the groundwater at the northern portion of the pond.

Also, as part of the groundwater alternative, we have a portion of Groundwater Alternative 4 for the West Hide Pile, and that involves in situ enhanced bioremediation, which will be used to treat benzene contamination at the Wells -- at the West Hide Pile. This alternative also includes institutional controls.

This is a figure that was presented in the proposed plan presenting an example of what enhanced bioremediation process may look like.

Next slide. The -- the Alternative

Halls -- HBHA-4 is to establish a storm water bypass and sediment retention with partial dredging and providing alternative habitat.

With this alternative, the southern portion of the Halls Book Holding Area Pond will be dredged, disposed -- the sediments will be dredged and disposed of off-site and restored.

The northern portion of the pond is included into the clean-up remedy as a sediment retention area to minimize contaminants migration downstream.

Also, as part of the alternative HBHA-4, the northern portion of the pond will intercept contaminated groundwater, maintain a chemocline in the southern -- in the surface water to degrade and sequester contamination and aerate surface water between cofferdams to enhance treatment.

Sediments that accumulate in the northern portion of the pond will require periodic dredging and off-site disposal.

A storm water bypass system will be constructed to divert surface water from Halls Brook to the southern portion of the pond.

Here is a figure illustrating what

alternative Halls Brook Holding Area Pond four looks like.

This is another figure illustrating the details of the series of cofferdams that would be installed for -- in the Halls Brook Holding Area Pond and the associated treatment with those cofferdams.

The Alternative HBHA-4 also includes the following: Capping and stabilizing sediments along 1,000 foot linear feet of the New Boston Street drainway -- drainway with an impermeable cap.

Capping and stabilizing soils adjacent to the NSTAR and MBTA rights-of-way with a permeable cap, and with this alternative, all wetlands losses will be compensated elsewhere in the watershed.

This figure is a close-up of the areas requiring the impermeable and permeable caps associated with Halls Brook Holding Area Pond alternative four.

Next is Near Shore Sediments Alternative 4, which is removal and off-site disposal of shore line sediments.

These sediments will be removed from the Wells G&H Wetland and Cranberry Bog Conservation Area, and those areas will be restored.

Deep Sediment Alternative DS-2 requires institutional controls to prevent or control potential exposures to contaminated sediments during potential future dredging activities.

Surface Water Alternative SW-2 requires monitoring of surface water in the Halls Brook Holding Area Pond as well as along the various portions of -- of the Aberjona River and Halls Brook Holding Area to evaluate the impact of contaminated groundwater discharge to the Halls Brook Holding Area Pond. This Alternative SW-2 works in coordination with Alternatives GW-2 and HBHA-4.

Lastly, the Surface Soil Alternative SS-2 and Subsurface Alternative SUB-2 requires institutional controls and -- with monitoring. The controls -- the controls will be established to -- the institutional controls will be established to prevent exposures to contaminated soils for both of those alternatives.

And the next steps are the formal public comment period will end on August 31st, and if people would like to submit written comments, they can submit them to -- by mail or through e-mail to myself, Joseph LeMay, at U.S. EPA Region 1 - New England, One Congress Street, Suit 1100 -- the mail code is HBO -- Boston, Mass. 02114, and my e-mail address is lemay dot joe at epa dot gov.

In the fall, EPA -- EPA expects to have reviewed all comments and signed a Record of Decision document. A summary of EPA's responses to public comments will be made available to the public at the information repositories, Woburn Public Library and EPA's records center and also on EPA's website.

And now I'll hand it back over to Bob.

MR. CIANCIARULO: Thanks for the summary, Joe, and also, again, what Joe ran quickly through is, obviously, in greater detail in the proposed plan and the feasibility study, both of which are available in those information repositories or on the web.

So with that, we'll begin the hearing, and we'll start with the first speaker, but...

Okay. She's going to let me sit down.

First we're going to hear from Mayor John Curran.

MAYOR CURRAN: Thank you.

I'd like to thank Joe LeMay and the EPA team for making this an open and informative process. I would like to also just go over a few things.

One is the -- just so that the -- so that the EPA understands the perspective of the City and what our major goals are throughout this process, I'd like to key in on the -- my thought process tonight, because that's what we are talking about.

The remediation proposal that you have -- did this go off? Can everyone hear me?

MR. CIANCIARULO: The microphone just went off.

(Recess)

MAYOR CURRAN: Okay. The remediation proposal that's on the table tonight -- obviously, I'm not a scientist, so I can't really comment as to whether it's accurate or not, but that is the primary concern of the City, is that the proposal that's on the table or the ultimate remediation for this site is the best possible remediation for the City of Woburn and provides the highest degree of public safety to the people that live here, the people that work here and the people that pass through here.

So that is our primary goal, and we would like to work with the EPA in that regard to make sure that the ultimate -- the ultimate solution is the best solution.

With that being said -- with that being said, the -- another concern that the City has is the process itself, the impact of the process itself on the City of Woburn.

As you know, Woburn has quite a history with the Industri-plex Site and the remediation that's taking place up there.

Fortunately, with -- through the help of the EPA, there are a lot of great things that have happened up in that industrial corridor.

We've recouped a tremendous amount of tax revenue. It's a booming area. It's unquestionably the first class office development that sits right on top of that whole site, which is a great success story, but what we are afraid of is the perception that further remediation has on the City of Woburn.

We're not saying that there should not be further remediation. Absolutely there should, but we just want to make sure that that process is as painless as possible and that people receive the necessary information to know that there isn't any real danger to human health at this point and that the ongoing work that's going on up there is not anything necessarily new. It's the continuation of a process that's been going on for -- for a very long time.

So we want to follow it through in that -- in that vain to make sure that -- that Woburn does not suffer the consequence of years ago from 1979 on, and we want to try to make this a positive thing for the City, in that there is no risk right now and that what we're doing is making sure that risk is eliminated from the future forward. So that's what our primary goal is.

With that being said, the proposal you have on the table tonight may be the right proposal. It may require more remediation; it may require less. I don't know the -- the ultimate answer to that question yet, but we will be looking at it.

I know there are other advocacy groups here that are also interested in further reviewing the proposal. So the requests -- I know that there are several on the table -- for additional time through the comment period is not necessarily a bad idea. I think it's a good thing, and we could certainly use that time productively.

As you know, we're in the middle of the summer, and sometimes it's harder to get -- get consultants and things moving as quick as you'd like them to.

So I think it's a valid request, and I would like to speak in favor of that request for an extension on the time, but I'll leave -- end my comments with those two primary interests, the best possible solution for that site and that it's done in the most positive way it can be done for the City of Woburn, and -- and, for the record, to date, it has been, I think, a positive experience with these last -- last few years, and I think the public has been well-informed, and we want to keep this moving along in that direction.

So thank you.

MR. CIANCIARULO: Our next speaker is Woburn City Councilor, Joanna Gonsalves.

MS. GONSALVES: I'm here this evening speaking as a representative of the Woburn City Council.

In our mid-July meeting, we sent Mr. Varney of the EPA a request for additional time. We are thankful for the additional 30 days, but we don't think it's enough. We've actually requested 90 days.

At the beginning of this Superfund study process, the study process itself, the City Council asked for a peer-review mechanism, so that we can have some environmental specialists take a look at your studies and final proposal, and what we were given was access to the TOSC grant, and we have received technical assistance from that group. We will be meeting with that group within the next couple of weeks.

However, I -- I feel that this is such an important process. It's been an important project. It will continue to be. I think it behooves the City, it behooves the EPA to have another set of educated eyes take a look at this proposal before you issue your Record of Decision. It would require more time, and we also are formally asking for the funds to help the City with this independent peer review.

We've been working cooperatively with the EPA for years. I'd like to see this relationship continue. So, please, give our requests some consideration.

Thank you.

MR. CIANCIARULO: Thank you.

Next, Linda Raymond from the Aberjona Study Coalition.

MS. RAYMOND: Thank you.

My name is Linda Raymond. I am a life-long Woburn resident. I am also the co-chairman of the Woburn Neighborhood Association and the treasurer of the Aberjona Study Coalition.

It is not just about Woburn. The Aberjona Study Coalition is a coalition of six community groups that represent over 225,000 residents whose cities and towns border the Aberjona River. The Aberjona Study Coalition is preparing a list of comments on the Draft Final

Feasibility Study and proposed plan.

One of my questions is regarding -- I know you cannot answer the question, but I want to address this.

My question is regarding a concern that we have had that was not clearly addressed by your response to our comments on the Baseline Human Health and Ecological Study. We are concerned and confused with the differences between the EPA and the State of Massachusetts Contingency Plan standards that are being used as a guideline to develop the remediation plan.

What if, for example, a residential property on Winter Street in Winchester is contaminated due to an overflow of the Aberjona River during a major storm? The property opener tries to sell their property. During sale, the land is tested, and the level of contamination exceeds the state standard, but not the federal standard established for the Aberjona clean-up. Which standard must the property owner meet before they can sell their property? If the property is found to be contaminated, who will be involved, the DEP or the EPA?

Thank you.

(Recess)

MR. CIANCIARULO: Sorry for that.

Next speaker, Jan Dolan from the Mystic River Watershed Association.

MS. DOLAN: Also a member of the Aberjona Study Coalition.

The Massachusetts Department of Environmental Management is updating the flood plane delineation in the Winchester area. The question is, will the EPA conduct samplings at sites secluded in this expanded flood plane that may be effected by contaminating elements from the Aberjona River?

Private residents and businesses located along the Aberjona have experienced frequent flooding problems, most recently in October '96, June '98, March '01 and October '03, and large areas such as the International Family Church property on Washington Street and town athletic fields such as Ciarcia Field, which is adjacent to Winchester High School and Ginn Field, which has a popular playground area have a long history of flooding.

A clear statement from the EPA delineating health risks to the residents of the area and health risks to the many athletes and children playing on the fields is requested.

Thank you.

MR. CIANCIARULO: Thank you.

Our next speaker is Adrian Rogers, Friends of Upper Mystic Lake.

MS. ROGERS: Thank you.

We, also, as a group have been looking -- working primarily in the lake and somewhat the Aberjona feeding into it, do appreciate all the attention that the EPA and all of you have given and the data that you have provided.

We are concerned that the planned remediations, although it's stated that they -- it appears that they will reduce inflow of contaminants into the lake, but the plans haven't -- don't really address the so-called hot spots that were found in the sediments, particularly in the upper forebays of the lake, and don't address whether they will continue to be monitored, and also, in particular, we ask what data there are and what the modeling use is in native data to indicate how effective the proposed plans are.

Clearly, they will remove toxins from the sediments that are there now. It appears that the carrying of these down the surface water and, perhaps, groundwater into the lake will be reduced. We don't -- we really have not been given data or projections as to how significant this impact will be on the river and the lake and looking on into the -- the future for the lake.

So we ask that more information be provided on these and that we also be given a plan, which is alluded to for continuing monitoring of the lake, particularly the upper forebays and the sediments.

MR. CIANCIARULO: Thank you.

The next speaker is Cindy Brooks of the Industri-plex Custodial Trust.

MS. BROOKS: Thank you.

My name is Cindy Brooks, and I am the president of Resources for Responsible Site Management, which is the Federal District Court Trustee for the Industri-plex Superfund Site

Custodial Trust.

I have been privileged to serve in that capacity since 1989 when the Custodial Trust was created as part of the Industri-plex Site Consent Decree.

Before entering specific comments into the record, the Custodial Trust would like to commend EPA, particularly Joe LeMay, for the dedication in undertaking this extensive and exhaustive effort that has gotten the Aberjona River clean-up to this point.

For the last 16 years it has been an honor to serve the fiduciary and other needs of the three distinct beneficiaries of the Custodial Trust. They are the City of Woburn, the potentially responsible parties known as the Remedial Trust and the U.S. EPA and the Massachusetts DEP.

In continued fulfillment of our obligations to these three beneficiaries, the Custodial Trust has sought to consider the fiduciary, environmental, regulatory, economic and other impacts that the proposed plan for clean-up of the Aberjona River may have on the three beneficiaries of the Custodial Trust.

For the record, the Custodial Trust also shares the multi-stakeholder goal of achieving the earliest possible clean-up for the benefit of the public at large.

Accordingly, the Custodial Trust offers the following two comments on the proposed plan: First, based on our assessment of the benefits that would inure to the City of Woburn, the Remedial Trust and the EPA and DEP, the Custodial Trust respectfully urges the EPA to consider the merits of a more cooperative, voluntary approach to implementing the final clean-up of the Aberjona River.

Such an approach would entail building upon, not abandoning, the unprecedented cooperation amongst the public and private entities as well as the local, state and federal governments that made Industri-plex the Superfund success story that it represents for all the stake-holders, especially EPA.

That success story, the story now known as Hope and Restoration in Woburn, became reality precisely because people like Joe LeMay, John

Beling, John's predecessor, Dan Winograd and others, as well as Anna Mayor and Andy Cohen from the DEP, all chose to think outside of the traditional box of regulatory enforcement.

There is a rare opportunity to build on a legacy of trust, communication and innovation spanning at least 10 years to 20 for many of the stakeholders here.

A concerted, participative process could minimize stigmatization of the City and potentially deliver a much more efficient and immediate clean-up.

Public and private resources that can and should be spent on clean-up and economic development would not be unnecessarily dissipated by issues of enforcement, liability, blame and litigation.

If there is no more than an even chance of success, it is difficult to justify why this unique, experienced group of stakeholders would not at least try to avoid creating more Superfund property, rekindling its stigma and delaying clean-up of the river.

Specifically the Custodial Trust

proposes a 60 day moratorium on the CERCLA enforcement process. During this time, the beneficiaries of the Custodial Trust could meet in an effort to establish a more collaborative framework for implementing the Aberjona River clean-up.

60 days may seem excessive, yet there appears to be no imminent human health threat, and it is decades that truly characterize the span of time during which Aberjona River has been studied, a span that promises to only grow longer into the future while awaiting clean-up under a traditional enforcement approach.

The Custodial Trust recognizes that EPA is fully within its authority to pursue the current traditional enforcement path. The Custodial Trust recognizes and, indeed, has benefited from the valuable incentives and tools it affords the EPA on accomplishing -- in accomplishing its important environmental missions.

Therefore, if, notwithstanding the good faith efforts of the stakeholders, including the Custodial Trust, the parties are unable to develop a meaningful framework for implementing a cooperative clean-up of the Aberjona River, EPA is always free to pursue the traditional enforcement route.

It is, therefore, with deference and optimism that the Custodial Trust earnestly and respectfully urges the EPA to lead this last multi-stakeholder effort.

The second comment from the Custodial Trust is made on behalf of two of our beneficiaries.

Notwithstanding the request for a 60 day moratorium, we must also respectfully request that the EPA extend the public comment period to allow the community groups, the City and the PRPs the reasonable amount of time that they have requested to review and comment on the proposed plan.

Granting such extensions would be consistent with the past and prospective schedule for work related to the Aberjona River as well as EPA's mission to protect public health and the environment.

Thank you.

MR. CIANCIARULO: The next speaker is

Kathy Barry, Aberjona Study Coalition.

MS. BARRY: I'd like to thank the EPA for, first, choosing a venue with air conditioning.

I am the president of the Concerned Citizens Network in Wilmington, Mass, and the president of the Aberjona Study Coalition.

I am particularly concerned about the hydrogeology in the Halls Brook Holding Area with the proposed plan.

My -- my questions are twofold. Will this remediation affect the present hydro -- hydrogeologic environment, both surface and groundwater flow in areas not only south, but east, west and north? And, number two, has the remediation been done elsewhere? If so, where, and how effective has it been with statistical measured analysis?

Thank you.

MR. CIANCIARULO: The next speaker is -- speaker -- excuse me -- is Bill Seuch, Goulston & Storrs.

MR. SEUCH: Good evening. My name is Bill Seuch. I'm an attorney at Goulston & Storrs in Boston, and I'm here on behalf of the Metro North Business Center, LLC.

They are the owner of a property, which is located downgradient from the boundaries of the existing Industri-plex Superfund Site, and I'm here to place some comments into the record regarding concerns about the proposed institutional controls that are part of the proposed remedy.

I would also like to thank the EPA and all the community groups in the City of Woburn for this continuing public outreach program and the opportunity to comment.

But our concerns are -- are really as follows: There are a number of innocent landowners who hold properties that are located downgradient from the Superfund Site, and I think it is very important for EPA to consider the impacts of having mandated institutional controls placed on these properties.

In many cases, there is a stigma in the marketplace when you are marketing, tenanting or financing a property that is burdened by an institutional control. Often times the presence of these controls can add significantly to transaction costs.

Every time you go to refinance a mortgage or find a new tenant or to sell your property, you have to hire an attorney or a consultant and explain the details of these institutional controls and the history of the neighboring Industri-plex Superfund Site. And, from our perspective, this is really a significant concern that may have impacts on property value. Those impacts would be bad for business owners and also bad for the City.

You know, we believe that it would be possible to accomplish the objectives here, which is to protect people from future groundwater exposures through an alternative mechanism, perhaps, a voluntary deed restriction program, perhaps, another program.

I think it's important to note that, under state law, a downgradient property owner in these circumstances would not be required to institute a deed restriction. There would be a filing made with the State. That filing would be available for public review, but there would be no deed restriction required for the same types and levels of contamination, and because of that, we really believe that EPA and others should consider the potential impacts of these deed restrictions.

We all acknowledge that this is a complicated process. The site has a long history, and there is planning of scientific data to be discussed here.

Accordingly, we would ask that the public comment period be extended and that groups be afforded additional time to review these issues, which really have the -- the possibility of affecting many people, including the innocent owners of these downgradient properties.

Thank you very much.

MR. CIANCIARULO: That's the end of my cards.

I don't know if there are any others who would like to speak.

MR. NATALE: Sorry for the cards.

My name is Patrick Natale. I'm the state representative for Woburn.

I think, probably -- most of what I have to say is, probably, backing up with what the mayor of Woburn, John Curran, had to speak of and Joanna Gonsalves.

I would appeal, I guess, to the EPA to work with the Neighborhood Association, the Aberjona Association and potentially the peer review group that the Woburn City Council is going to work with.

I would think that -- I know most people asked for about a 90 day extension, but what I would ask is that we work closely with these groups and that whatever time they need, that we give it to them.

I think that these sites have been contaminated for well over 100 years. I don't think 30 days, 60 days, 90 days is going to make a difference as somebody else said here.

I know that the EPA, obviously, is on a time schedule, but I think if, you know, the neighborhood associations and our environmental group needs another 30 days, I would ask that that be given. I know that the EPA has worked very well over the years in the Superfund.

I live very close to New Boston Street down at the bottom of Merrimack. I'm as close as anybody to this project. I think, again, as many parents are here, with the history of this site that, you know, we must ensure the safety of -- of this project, and I think that, you know, working forward we need to work with everybody.

I'm also a member of Woburn's Conservation Commission, former member, and I would ask that Joe LeMay specifically work with Michael Benenate, who's to the right of me, who's the chairman of the Conservation Commission. He probably knows these areas as well as anybody. I think he can be a great asset to this project.

I think that, you know, we are going into environmental and conservation areas that are going to be impacted, and work is going to be done. So we want to maintain, you know, the consistent work that the Conservation Commission has done throughout the years in Woburn and not allow, you know, great impact on the environment, because there are, you know, wildlife, and there are conservation issues as well in there.

I think that, you know, the two issues for me, again, are the safety issues for the public and just taking a step back and -- and letting, you know, these groups that want to take a second look at the proposed final plan and let them give their comments. I think it could be quite helpful.

I know that, you know, they are asking for 90 days, but I would ask that we work very closely, and give them the time they need. I know you guys are on a timeline, but that's pretty much what I wanted to say.

I'm not sure if Michael is going to get up tonight and talk --

MR. BENENATE: I am.

MR. NATALE: -- but I think that he knows these areas as well as anybody. He has walked you through them all, and I think he can be a great asset, and he's the guy that you really need to speak with about doing any work in these areas.

So, if Michael wants to get up, I will hand it over to him.

MR. BENENATE: I do.

MR. CIANCIARULO: He's got his card in his hand. Okay.

MR. BENENATE: I'm also speaking as a

private citizen.

I have concerns. There's nothing -- nothing --

MR. CIANCIARULO: Michael Benenate for the record.

MR. BENENATE: Nothing in the plan discusses the safe handling of the contaminated soils, you know, once you dredge them out, how you handle, them how you store them, how you ship them. There's nothing in your plan on that.

The other thing is the location and design of replicated areas. You talk about in the plan replicated -- you're going to be doing downstream, other wetlands areas adding to the -- adding to the wetlands areas, but you have no locations; you have no plans on that.

Planting schemes, I know that's down the road, but nothing is mentioned about planting scheme for replicated areas, and also how long the replicated areas may be monitored, you know, two years, three years, five years. It takes a while to -- to make sure that these areas actually become viable.

Another little interesting issue.

There's nothing mentioned about if you come across an archeological site. I personally think you may come across a native American site if you're digging around the cranberry bog area, and you don't have any -- any plans -- contingency plans mentioned in your plan on something like that.

And like Representative Natale said, the Conservation Commission in our discussions and meetings are looking forward to having you people come in front of us to start discussing your plans and options, also, and you can make arrangements by calling the office and coming in informally right at any time that you'd like to. That's it.

Thank you.

MR. CIANCIARULO: Just state your name and affiliation.

MR. CIRIELLO: John Ciriello. I'm the Ward 6 Alderman up in North Woburn and also a member of the Aberjona Study Coalition.

I'd like to also request the 90 day extension period that the Woburn City Council has requested, and I think it's very important to spend a little extra time on this to -- to review all the material.

The first question is the source of contaminants north of the cofferdam. I think it's great that everything south is going to be improved as far as contamination moving off-site, but what happens to the actual source of all of the contamination? Is it going to remain in place forever? Is there -- is there going to be a concern later on sometime in the future with whatever will be removed?

The second question is, is there a backup plan to the backup plan of the bypass of the cofferdam? What if that fails? Where does -- where does the water go? Does it go sideways? Does it go into properties, residential and commercial? I just want to know if there's backup to the backup.

Thanks.

MR. MENEY: Good evening. For the record, my name is Paul Meney. I'm the executive director of the Woburn Business Association.

I, too, would go on record as being in favor of the extension of time. I say that, because the fact is it's a learning process for a lot of people, including myself.

I can remember the last time I talked to Joe LeMay, which was probably six or seven months ago, and I, for one, did not know that there was a Industrial-plex Site 2. I always dealt with one on the other side of 128, and so I, for one, did not know that you came on this side over to Salem Street, including G&H Wells and back up 93.

But, with that being said, Woburn is the focal point as much as Wilmington and/or Winchester and/or Medford. We are the focal point of this ongoing situation. I won't use the word problem. Ongoing situation. And every time that you or the news media brings up problems in -- whether it's the Aberjona River, whether it's the Industrial-plex Site or whether it's the capping of a dump -- there seems to be an element that remembers those days of a dark cloud over the City of Woburn, which the mayor had alluded to, going back in to the late '70s.

So I -- it's imperative for you to make sure that everything is said, is said correctly, that everything is done -- under your agency is done correctly and that all of the information, no matter how good or bad it is, is disseminated without any question.

Lastly, there are a tremendous amount of people that not only own property in this area and pay very, very good taxes to this community, and there is a tremendous amount of people that come to work here every day, and there are also people that live in this vicinity. All of those -- all of those sometimes ask questions not only of me, but of other city officials, and every time we mention about our hazardous waste problem, we sometimes scare the heck out of people when we say it, and a lot of people that come into this community ask the question, How safe is Woburn? How safe is our drinking water?

There are many times that people want to know where is the hazardous waste that was taken out through those hundred plus acres up around the Anderson Transporation. What is that air chamber house on top of the hill by the Anderson Transportation Center?

I've gone into Arquile many times, now Raytheon. There are employees there that ask those questions.

So I say this to you: Make sure that

you get out as much information as you can. Do not -- and I emphasize that -- do not hold anything back from the general public or the community officials. I'm not saying that that was done in the past, but I think in some cases, it was.

Thank you.

MR. MEDEIROS: For the record, my name is Paul Medeiros. I am the president of Woburn City Council.

To me, it's an issue of fairness and openness to the communities, not just Woburn, but Winchester and Wilmington, all the contiguous communities to the City.

EPA and DEP had over 16 years to review and study and come up with this plan, and you give the cities, the residents, the businesses 30, now 60 days to come up and comment on this. I think it's just wrong. I don't know if six months would be enough to comment.

I've seen the volumes of information that you people send to us, and with -- without proper manpower, I don't think we can sensibly and openly answer what you've given us. I just -- I don't think we have the expertise on-board.

We have some very good people in this city. We have some very good engineers, and I just don't think that we have the people that are capable of getting the answers to the -- to our communities that we need.

I'm, obviously, concerned with the plan, the impact and the end result on Woburn, our future health and our community.

There's no doubt an issue, but the City, our residents, our business owners, they need -- they need answers. They need assure -- they need assurances that this is the right thing to do, the right way to go about it and the best way to proceed using proven methods and that the end result puts that -- this whole issue finally behind us.

I happen to live in the Wells G&H Superfund Site. When I bought my home, I was naive. I didn't know what was around me. You know, they say buyer beware. So I learned every possible thing I could, which is why I got involved in politics.

This project clearly needs peer review.

We've requested it. I think the communities deserve it, and I'm asking the EPA to do the right thing.

TOSC I don't think is the right thing, and I don't think it's any secret that the City is looking for peer review.

Thank you.

MR. CIANCIARULO: Others wishing to comment?

MS. BARRY: Yes. Thank you. I'm sorry.

Kathy Barry again, president of Aberjona Study Coalition.

Again, I believe that the Aberjona Study Coalition wrote a letter, a formal request for an extension to October 1st, and I just want to go on record this evening to say that we are -- we would like that to be adhered to as well.

Thank you.

MR. CIANCIARULO: Okay. If there are no others...

Thank you for participating in the meeting. Remember, I've heard a lot requests for extension, but as we stand right now, the comment period closes on August 31st.

Comments can be provided in writing by a variety of methods that Joe mentioned, fax, e-mail, address mail.

The hearing is officially closed. Thank you all for coming.

(Whereupon the hearing concluded at 8:00 p.m.)

CERTIFICATE

I, Valerie Rae Johnston, Registered Professional Reporter, do hereby certify that the foregoing transcript, Volume I, is a true and accurate transcription of my stenographic notes taken on Wednesday, July 27, 2005.

Valerie Rae Johnston
Registered Professional Reporter

Word Index

US EPA New England
Superfund Document Management System
Image Target Sheet

SDMS Document ID #237563

Site Name: INDUSTRI-PLEX

File Number:

Purpose of Target Sheet:

[ ] Oversized [ ] Color

[X] Non-Paper Media [ ] Other (Provide purpose below)

Document Type this Target Sheet Replaces:

[ ] Map [ ] Photograph [ ] Graph/Chart

[ ] Video [X] Compact Disk [ ] Other (Specify below)

Description or Comments: Industri-Plex Superfund Site-Proposed Plan Public Hearing

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SDMS DocID 237182

Joe Lemay/R1/USEPA/US
08/16/2005 07:39 AM

To FITWALKER1@aol.com
cc Angela Bonarrigo/R1/USEPA/US@EPA
bcc
Subject Re: Question For You - Information

No. The design stage of the superfund cleanup process for Industri-plex OU-2 (and including Wells G&H OU-3) will occur after the Record of Decision.

Joe-

FITWALKER1@aol.com

FITWALKER1@aol.com
08/11/2005 01:10 PM

To Joe Lemay/R1/USEPA/US@EPA
cc
Subject Question For You - Information

Joe,

Is there information available for review beyond what was made available at your website and through meetings?

If there is information available (for example design plans) how can it be obtained and or accessed?

Thanks
Linda

4.1

SDMS DocID 237183

Joe Lemay/R1/USEPA/US
08/16/2005 07:34 AM

To design@cummings.com
cc Angela Bonarrigo/R1/USEPA/US@EPA
bcc Bob Cianciarulo/R1/USEPA/US@EPA; John Beling/R1/USEPA/US@EPA; bullardg@ttnus.com
Subject Re: EPA June 30th Proposed Plan Meeting follow-up

Mr. Greg Flaherty, Cummings Properties:

Based upon the address information you provided yesterday, 330 Washington Street is a property situated off of Washington Street just north of the intersection with Cedar Street. The back (west side) of this property butts up to the access road leading to the Mass Rifle Association. This property would not be subject to institutional controls for Industri-plex Operable Unit 2 (and including Wells G&H Operable Unit 3, Aberjona River Study) based upon the June 2005 Proposed Plan.

Sincerely,

Joseph F. LeMay
Remedial Project Manager
Office of Site Remediation and Restoration

Greg Flaherty <design@cummings.com>
08/15/2005 02:41 PM

To Joe Lemay/R1/USEPA/US@EPA
cc
Subject Re: EPA June 30th Proposed Plan Meeting follow-up

Mr. Joseph F. LeMay

Thank you for your response.
Regarding Item-1, the legal address for 500 West Cummings Park is "330 Washington Street, Woburn, MA."

Sincerely,
Gregory Flaherty, P.E.

----- Original Message -----
From: <Lemay.Joe@epamail.epa.gov>
To: <design@cummings.com>
Cc: <Bonarrigo.Angela@epamail.epa.gov>
Sent: Monday, August 15, 2005 9:10 AM
Subject: Fw: EPA June 30th Proposed Plan Meeting follow-up

> Greg Flaherty, Cummings Properties
>
> Below is a response to your July 8, 2005, email (follow-up to your
> questions posed during the EPA June 30th Proposed Plan Meeting):
>
> 1) 500 Cummings Park is not an address that the Woburn Assessors
> database recognizes. The database requires either the specific
property
> address,the map/lot number, or the tax account number. Please provide
> this information or a map illustrating the location of the property.
>
> 2) Institutional Controls are described on page 4 of the Proposed
Plan.
> Also, the institutional controls for the preferred alternatives are
> further described on page 4-8 (SS-2), page 4-13 (SUB-2), page 4-18
> (GW-2), and 4-36 (DS-2) in the June 2005 Feasibility Study (FS). As
> indicated in the FS, the "operative depths" are 0-3 feet for "SS"
areas
> (aka surface soils) and 3-15 feet for "SUB" areas (aka subsurface
> soils).
>
> Further details of the institutional controls will be established
during
> the remedial design.
>
> Sincerely,
>
>
> Joseph F. LeMay
> Remedial Project Manager
> Office of Site Remediation and Restoration
>
>
>
> Greg Flaherty
> <design@cummings
> .com>
To
> Joe Lemay/R1/USEPA/US@EPA
> 07/08/2005 02:39
cc
> PM Angela Bonarrigo/R1/USEPA/US@EPA
>
Subject
> Re: EPA June 30th Proposed Plan
> Meeting follow-up
>
>
>
>
>
>

>
>
>
>
> Thank you very much for your response.
>
> I would like some additional information on two other issues:
>
> 1) Is 500 West Cummings Park located within the boundaries for any
> Institutional Controls? If so, which ones?
>
> 2) What is the nature of the restrictions on excavation in any of the
> "controlled areas" affecting the properties I have inquired about?
> Specifically, what would be the operative depths at which restrictions
> would apply? What is the nature of the restrictions?
>
> Thank you,
> -Gregory Flaherty, P.E.
>
>
>
>
> ----- Original Message -----
> From: <Lemay.Joe@epamail.epa.gov>
> To: <design@cummings.com>
> Cc: <Bonarrigo.Angela@epamail.epa.gov>
> Sent: Wednesday, July 06, 2005 1:55 PM
> Subject: EPA June 30th Proposed Plan Meeting follow-up
>
>
> > Gregory Flattery, Cummings Properties:
> >
> > At the end of EPA's June 30, 2005, Proposed Plan information
meeting,
> > you asked whether the following five properties were inside or
outside
>
> > of EPA proposed institutional controls area for surface and
subsurface
>
> > soils alternatives SS-2 and SUB-2. The Woburn's Assessor Database
has
>
> > been reviewed, and a response has been provided after each property
> > address.
> >
> > 1) 12 Cabot Road; Assessor Map Code 150102: Both surface (SS-2) and
> > subsurface soil (SUB-2) alternatives would apply to this address;
> >
> > 2) 35 Cabot Road; Assessor Map Code 150105: None of theses
> alternatives
> > apply to this address;
> >
> > 3) 10 Commerce Way; Assessor Map Code 200102: Both surface (SS-2)
and
>
> > subsurface soil (SUB-2) alternatives would apply to this address;
> >
> > 4) 18 Commerce Way: No address exists in Woburn's Assessor
database.
> > EPA would need more information from Cummings Properties regarding

the
>
> > specific location of this property; and
> >
> > 5) 34 Commerce Way; Assessor Map Code 200104: Subsurface soil
> > alternative (SUB-2) would apply to this address.
> >
> > Please let me know if you have any further questions.
> >
> > Joseph F. LeMay, PE
> > Remedial Project Manager
> > Office of Site Remediation and Restoration
> >
>
>
>

OSRR
R1-05-01-2828

COMMONWEALTH OF MASSACHUSETTS

MASSACHUSETTS SENATE

STATE HOUSE, BOSTON 02133-1053

SENATOR ROBERT A. HAVERN
ASSISTANT MAJORITY WHIP
4TH MIDDLESEX DISTRICT
ROOM 109D, STATE HOUSE
TEL. 617 722-1432

COMMITTEES:
FEDERAL FINANCIAL ASSISTANCE (CHAIR)
POST AUDIT AND OVERSIGHT
TAXATION

RECEIVED
AUG 29 2005
OFFICE OF THE REGIONAL ADMINISTRATOR

August 22, 2005

Robert Varney
Regional Administrator
One Congress Street, Suite 1100
Boston, Massachusetts 02114

RE: EPA's Draft Feasibility Study for Aberjona River (Industri-plex and Wells G&H Federal Superfund Sites)

Dear Mr. Varney:

I am writing to request your immediate and personal assistance in addressing the requests related to the draft Feasibility Study for the Aberjona River (the "Draft FS") set forth in the attached July 21, 2005 letter to you from the Woburn City Council.

The Woburn City Council, the local community group (Aberjona Study Coalition, Inc.) and many other have requested additional time to review the complex clean-up plan proposed by the EPA. Their requests are completely reasonable, particularly considering the lack of any imminent human health threat, at least according to EPA's own studies. Since industry has had over one hundred years to contaminate the river, and EPA has had more than fifteen years to study the river, I am sure you would agree that this community deserves more than sixty days to review the final clean up plan.

Furthermore, as requested in my last letter to you of July 25, 2002, as well as in the attached letter from the Woburn City Council, EPA must ensure that the City of Woburn has the necessary funding and access to the appropriate technical resources needed to assist the City in its review of the Draft FS. In your July 30, 2002 response to the City Council, you agreed to consider their request for external peer review if so requested. Since the EPA-established deadline for public comment is August 31, 2005, I must urge you to move quickly to consider their July 21, 2005 good faith request to you for re-consideration of external peer review. Thank you in advance for honoring your promise in that regard.

SDMS DocID 237725

INDUSTRI-PLEX
4.01
237725

Lastly, I would like to re-visit your original commitment to an open, public and transparent process. There appears to be a great deal of apparent confusion about the EPA's proposed plan, a number of requests for more time to look at it and "surprise" (at least based on feedback from some of my constituents) by what EPA has proposed, suggesting that the process and communications are not, in fact, open or transparent. The success of what has been accomplished at the Industri-plex Site is largely the result of collaboration of all three levels of government and the public and private sectors. I must urge you to personally get involved, Mr. Varney, to re-instate the dialogue that was once the cornerstone of what has been and can be accomplished in Woburn, Massachusetts. Perhaps EPA should consider meeting informally with officials from the City of Woburn, the community, major impacted landowners, and other stakeholders. I would be happy to facilitate such a meeting.

Please do not hesitate to call me with any questions. Thank you in advance for your assistance with this matter.

Sincerely,

ROBERT A. HAVERN, State Senator
Fourth Middlesex District

Attachments

Cc: Woburn City Councilors:

President Paul Medeiros, Alderman, Ward 5
Alderman Charles E. Doherty, Ward 1
Alderman James E. McSweeney, Ward 2
Alderman Scott D. Galvin, Alderman Ward 3
Alderman William N. Booker, Ward 4
Alderman John A. Ciriello, Ward 6
Alderman Thomas L. McLaughlin, Ward 7
Alderman-at-Large Paul J. Denaro
Alderman-at-Large Joanna Gonsalves

State Representative Jay R. Kaufman
The Honorable John Curran, Mayor, City of Woburn
The Honorable Edward Markey, US House of Representatives
The Honorable Edward Kennedy, US Senate
Aberjona Study Coalition, Inc.
Thomas Alperin – National Development
Susan Brand – Cummings Properties

JOHN KERRY
MASSACHUSETTS

OSRR
R1-05-001-2740

RECEIVED
AUG 25 2005
OFFICE OF THE REGIONAL ADMINISTRATOR

United States Senate

WASHINGTON, DC 20510-2102

COMMITTEES:
COMMERCE, SCIENCE, AND TRANSPORTATION
FINANCE
FOREIGN RELATIONS
SMALL BUSINESS

One Bowdoin Square
Tenth Floor
Boston, MA 02114
(617) 565-8519

August 22, 2005

SDMS DocID 237723

Robert W. Varney
Regional Administrator, New England Office
EPA New England, Region 1
1 Congress St. Suite 1100
Boston, MA 02114-2023

INDUSTRI-REX
4.01
237723

Dear Administrator Varney:

I am forwarding to you a copy of a correspondence from the Aberjona Study Coalition requesting that the EPA grant a 90 extension to the comment period for remedial draft reports regarding the Aberjona River Watershed.

It is the desire of this office to be responsive to all inquiries and communications. I respectfully ask for your assistance in resolving the issues outlined in the attached correspondence.

In addition to sending a response to the Aberjona Study Coalition's correspondence, I respectfully ask that you please convey a copy of your letter to Tyke Crowley of my Boston office.

I thank you for your cooperation in this matter.

Sincerely,

John F. Kerry
United States Senator

Enclosures:
The Aberjona Study Coalition's Correspondence
JFK/fbc

ASC

Aberjona Study Coalition, Inc
10 North Maple Street
Woburn MA 01801-1407
www.aberjonastudy.org

(781) 935-2438 *email info@aberjonastudy.org*

V

August 1, 2005

Congressman Edward J. Markey
5 High Street
Suite 101
Medford, MA 02155

Subject:
Draft Final MSGRP Remedial Investigation Report Industri-Plex Site/Wells G&H
Draft Final Feasibility Study:Remedial Investigation/Feasibility Study June 30 2005
Proposed Plan Industri-Plex Superfund Site Operable Unit 2 (including Wells G & H Operable Unit 3) Woburn, MA

Dear Congressman Markey:

We, the Aberjona Study Coalition, Inc. are writing to you to request that you use the power and influence of your office to convince the EPA that a 90 day extension to the comment period for the above reports is necessary. To date the EPA has extended the comment period for only an additional 30 days to August 31, 2005.

The Aberjona Study Coalition, Inc. (ASC) is an organization of six community groups: Woburn Neighborhood Association, Inc., Mystic River Watershed Association, Friends of the Upper Mystic Lake, Concerned Citizens Network, Woburn Residents Environmental Network and Medford Boat Club representing over 225,000 residents who are affected by the Aberjona Watershed from the 7th Congressional District.

On July 2, 2005 The Aberjona Study Coalition, Inc. formally requested an extension to the 30-day comment period for the Draft Final Feasibility Study: MSGRP Remedial Investigation/Feasibility Study issued on June 30, 2005 as well as the Proposed Plan listed above.

Due to the complexity of the reports, we the Aberjona Study Coalition, Inc. believe that the EPA comment period from July 1, 2005 through August 31, 2005 is unacceptable. Speaking on behalf of the average person residing along the Aberjona River Watershed it is impossible to review and comment on 12 volumes: Industri-Plex Site Multiple Source Groundwater Response Plan Remedial Investigation Report Operable Unit 2 which contains 3,551 KB with links to 217 additional PDF files including the Draft Final

Feasibility Study and Proposed Plan which was just released on June 30, 2005 as listed on the EPA Website: www.epa.gov/ne/superfund/sites/industriplex and www.epa.gov/ne/superfund/sites/wellsgh

The Aberjona Study Coalition, Inc. in conjunction with our Technical Advisors from Cambridge Environmental, Inc. urge you to request an extension to the comment period for the Draft Final Feasibility Study: Remedial Investigation/Feasibility Study as well as the Proposed Plan.

Sincerely,

Linda A. Raymond

Linda A. Raymond, Treasurer
Aberjona Study Coalition, Inc.

Cc:
Congressman Edward M. Kennedy
Congressman John F. Kerry

Kirkpatrick & Lockhart Nicholson Graham LLP

75 State Street
Boston, MA 02109-1808
617.261.3100
Fax 617.261.3175
www.klng.com

August 24, 2005

Franklin G. Stearns
617.951.9275
Fax: 617.261.3175
fstearns@klng.com

Joseph F. LeMay
Remedial Project Manager
US EPA New England
One Congress Street
Suite 1100 (HBO)
Boston, MA 02114-2023

Re: Comment by New England Plastics Corporation on Industri-plex Operable Unit 2 (including Wells G&H Operable Unit 3), Woburn, MA

Dear Mr. LeMay:

This letter responds to your request for public comment on your June 30, 2005 *Notification of Potentially Interested Party of EPA's Forthcoming Proposed Cleanup Plan for the Industri-plex Superfund Site, Operable Unit-2, and including Wells G&H Superfund Site, Operable Unit-3, Aberjona River Study, Woburn, Massachusetts.*

New England Plastics Corporation is an interested party because it is performing response actions at its own property at 310 Salem Street, Woburn, MA pursuant to the Wells G&H First Operable Unit Consent Decree with US EPA and other interested parties dated September 24, 1990.

Our understanding from review of the Proposed Plan for Wells G&H Operator Unit 3 is that EPA is proposing to excavate, dewater, and transport/dispose off-site approximately 2,100 cubic yards of arsenic-contaminated sediments from the Aberjona River wetland area proximate to Wells G&H. Institutional controls are also proposed for the deeper impacted sediments in this area.

With regard to arsenic and its relation with the New England Plastics site, we offer the following information:

- Arsenic is not nor has ever been used in any manufacturing processes conducted by New England Plastics or its former tenant.

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- The New England Plastics property is not adjacent to the wetlands area and there is no known contaminant pathways via surface run-off, storm water drains, or subsurface utilities for direct discharge from the property to the wetlands.
- Groundwater flow across the New England Plastics property is in a southerly direction; whereas, the impacted wetlands area proposed for excavation is located northwest of the New England Plastics property (e.g., wetlands are cross–gradient).
- Groundwater at the New England Plastics site has been sampled for arsenic analyses on two separate occasions. In June 1988, two wells (EPA-1 and EPA-2) were sampled for arsenic by EPA contractors and the results indicated that concentrations were below maximum contaminant levels (MCLs). Groundwater was recently sampled in July 2005 from well couplets (overburden and shallow bedrock) NEP-101/NEP-101B and EPA-1/NEP-106B using low flow sampling techniques and analyzed for total arsenic. All samples were reported as non-detected below the laboratory's minimum reporting limit of 8 micrograms per liter (ug/l), which is below the MCL of 10 ug/l.

Our reading of the Proposed Clean Up Plan suggests that all other actions being considered for these Operable Units relate to either the Industri-Plex site or other properties not previously parties to the Wells G&H Operable Unit 1 Consent Decree.

We hope this is helpful to you in your determination of further required actions associated with this Proposed Clean Up Plan.

Sincerely,

Franklin G. Stearns

cc: Michael Famiglietti, New England Plastics
Jeffrey Hamel, Woodard & Curran.

UNITED STATES POSTAGE
PITNEY BOWES
02 1A $ 00.60[0]
0004381609 AUG 25 2005
MAILED FROM ZIP CODE 02109

Franklin G. Stearns
Kirkpatrick & Lockhart Nicholson Graham LLP
75 State Street
Boston, MA 02109-1808

Joseph F. LeMay
Remedial Project Manager
US EPA New England
One Congress Street
Suite 1100
Boston, MA 02114-2023

4HBO

SDMS DocID 237561

Paul Medeiros
<pmedeiros@sigcom.com>

08/24/2005 07:20 AM

Please respond to
pmedeiros@sigcom.com

To Joe Lemay/R1/USEPA/US@EPA

cc "Paul Medeiros (E-mail 3)" <paulderman@prodigy.net>

bcc

Subject FW: Kraft

4.1

Joe
I don't believe I got an answer from you on this. Please advise. 237561
Thanks
PM

-----Original Message-----
From: Paul Medeiros [mailto:pmedeiros@sigcom.com]
Sent: Friday, May 27, 2005 1:30 PM
To: Joe LeMay (E-mail)
Cc: Paul Medeiros (E-mail 3)
Subject: Kraft

Joe
Kraft foods on Montvale avenue / Hill Street at Rte 93 currently draws water from Walkers pond aka Whitemore pond on Montvale Avenue. They have applied with the DEP to draw more or a larger quantity. My questions are: By drawing water from the aquifers that surround this pond are they drawing or could they be drawing any of the chemicals towards and possibly into this body of water or aquifer? Could they also be drawing an amount of these chemicals into their plant? If they increase the amount of draw would that draw possibly contaminated water into the body of the water, aquifer or their process? Lastly, there is some concern on the impact on the water level, health issues to humans and animals as there is no dam or any control mechanism to keep the pond level elevated and stable. Please get back to me.
Thanks

Paul A Medeiros
City Council President
Alderman Ward 5
9 Marietta Street
Woburn, MA 01801
781-938-0297
paulderman@prodigy.net
Please check out my website at:
www.geocities.com/paulderman

Gail French
<gail_french@hotmail.com>
08/25/2005 09:18 AM

To Joe Lemay/R1/USEPA/US@EPA
cc
bcc
Subject extension requested for Industriplex

Dear Mr. Lemay,

I know that you have already received many requests to extend the comment period for the Industri-plex proposed cleanup. Please add my request to that list.

I am a member of the Mystic River Watershed Association, and am that organization's representative to the Aberjona Study Coalition. We have been very busy reviewing the RI and FS since they were released. As you know, ASC was awarded a TAG. We have been working fast and furious with our consultant, Cambridge Environmental, to review the documents. However, 60 days is simply not enough time for sufficient analysis of such lengthy documents.

With over one hundred years of contamination and many years of EPA involvement, I think it is only fair that you extend the deadline another 30 days, for the 90-day comment period everyone first requested. The summer is a particularly difficult time for a short review period because many people are on vacation.

I'm sure that you are aware of the flood studies conducted by the Corps of Engineers and by ENSR (for FEMA). It is my understanding that the Corps study finds increased flooding in the Aberjona River through Winchester, and the ENSR study reports increased flooding in Halls Brook. These results are relevant to your examination of the flood plains in Winchester and your proposed remedy in the Halls Brook area, and I think they need to be considered.

Thank you for your consideration.

All the best,

Gail French
Mystic River Watershed Association and Aberjona Study Coalition
32 Garrison St, Apt 40-504
Boston, MA 02116
(617) 536-4984

OSRR
R1-05-C01-2995

Congress of the United States
House of Representatives
JOHN F. TIERNEY
MASSACHUSETTS
SIXTH DISTRICT

August 26, 2005

Mr. Robert W. Varney
Regional Administrator
U. S. Environmental Protection Agency Region 1
One Congress Street Suite 1100
Boston, MA 02114

Industri-Plex
4.1
237501

Dear Administrator Varney:

I am writing to express my support for the request for an extension of the public comment period made by the Woburn City Council and other interested parties in connection with the Final Draft Clean-up Plan for the Industri-Plex Superfund Site OU-2/Wells G&H Superfund Site OU-3/Aberjona River ("Plan"). I have conferred with my colleague Edward Markey and join him in asking you to reconsider EPA's decision to close the public comment period on August 31, 2005.

It is my understanding that the EPA and other interested parties have been investigating and studying the Aberjona River and the related Superfund sites for over a decade. The proposed Plan involves a $26 million clean-up that will have a significant impact on a number of Woburn businesses and the Woburn community-at-large. Everybody acknowledges the complexity of the issues involved and the substantial long-term impacts that the Plan will have upon the community. I am advised that all of the interested parties – Mayor Curran, the Woburn City Council and other community and environmental groups – that have been involved with the process to date concur that additional time is required in order to provide them the opportunity to adequately evaluate and comment on the Plan.

To date, the EPA has worked with all interested parties in Woburn in addressing several Superfund related issues. Woburn city leaders and committed citizens have been engaged in the process. I know that the EPA has gone to great lengths to assure their full participation in the process, including the extension of the original comment period by thirty days. I respect all the work that has been done cooperatively to this point in time. I also respect the judgment of those who have been so intimately involved and believe that the request for an additional extension of time for public comment is reasonable and made in good faith. Meaningful and informed dialogue between the EPA, the City of Woburn and all other interested parties is essential before finalization and implementation of any remedial plan.

120 CANNON HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-8020
http://www.house.gov/tierney

17 PEABODY SQUARE
PEABODY, MA 01960
(978) 531-1669
LYNN (781) 595-7375

It is also my understanding that the City of Woburn has requested technical assistance and an external peer review of the Plan. I trust that the City's request will receive the serious consideration that it deserves. The opportunity to receive an eternal peer review and an extension of time to submit informed comments on the proposed Plan might provide the basis for building further unified support for the final Plan and assure full cooperation of all interested parties as the EPA and the City move forward.

Much progress has been made on what has been a very complicated and sensitive community challenge, I believe that by granting the requested additional extension of time for public comment and offering the City the chance to obtain an external peer review the EPA will be taking positive steps toward building public confidence in the process and assuring the successful implementation of the final Plan.

Thank you for considering my comments on the matter.

Sincerely,

John F. Tierney
Member of Congress

JFT/gmb

EDWARD J. MARKEY
7TH DISTRICT, MASSACHUSETTS

ENERGY AND COMMERCE COMMITTEE
RANKING MEMBER
SUBCOMMITTEE ON
TELECOMMUNICATIONS AND
THE INTERNET

SELECT COMMITTEE ON
HOMELAND SECURITY

RESOURCES COMMITTEE

Congress of the United States
House of Representatives
Washington, DC 20515–2107

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WASHINGTON, DC 20515–2107
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FRAMINGHAM, MA 01702
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www.house.gov/markey

August 25, 2005

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Mr. Robert W. Varney
Regional Administrator
U.S. Environmental Protection Agency Region I
One Congress Street, Suite 1100
Boston, Massachusetts 02114

Dear Administrator Varney,

I am writing in strong support of the City of Woburn's request for an extension of the comment period for the EPA's proposed cleanup efforts at the Industriplex site/Wells G&H site. I concur with Woburn's City officials, their state house delegation and community members that more time is needed for review and comment and I respectfully request that you reconsider your decision to keep the August 31, 2005 deadline for comment as outlined in the August 5, 2005 EPA letter to the Woburn City Council which states that the comment period would stay at 60 days.

In addition, I support the City of Woburn's request for external peer review. In a letter sent to the City Council on July 30, 2002, you stated that the Council could request an external review for the draft risk assessment. The City Council sent a letter to the EPA making a request for external peer review on July 21, 2005. It is my hope that the City's request will be honored.

The community is in agreement that additional time is needed to review the proposed plan. I have been contacted by Mayor John Curran, the Woburn City Council, the Aberjona Study Coalition, and many other community and environmental groups in the Woburn area. The Aberjona Study Coalition, despite having technical advisors for the project, is requesting additional time to fully review the proposed plan. A full review of the plan should allow the entire community to stand behind the actual implementation and create greater cooperation on the project.

Considering the complex and painful history the community of Woburn has had with Superfund, it is important to not underestimate the significance of evaluating every aspect of remediation for the people who live in Woburn. While I have full faith in the efforts of the EPA and thank you for extending the comment period to 60 days from the original designation of 30 days, the community must be given a reasonable amount of time to review the proposed cleanup plan.

I am also concerned that the Town of Winchester may not have been consulted on the EPA's cleanup proposal of the Aberjona River. I have worked closely with officials from Winchester and the U.S. Army Corps of Engineers to mitigate the flooding of the Aberjona River which periodically devastates Winchester homes and businesses. Since the EPA's proposal may have downstream consequences, could you please address whether the Town of Winchester and/or the U.S. Army Corps of Engineers has been involved in the development of the proposal or briefed on the possible impacts it will have on flood mitigation efforts in Winchester.

The Aberjona River is a treasured resource in my congressional district. I am eagerly awaiting its cleanup and ultimate recreational use. All of the involved parties, including the EPA, agree that we are all working towards a better Woburn and a better Aberjona River. But, I fear that implementation of the EPA's cleanup plan without the support of the community will mar the future of the Aberjona, and the efforts of the EPA to strengthen and improve the community will by jeopardized by the community's suspicions of the EPA's intent and accelerated timetable.

If you have any questions, please contact Joe Dalton of my Medford District Office at (781) 396-2900. Thank you for your assistance in this matter.

Sincerely,

Edward J. Markey

Edward J. Markey

goulston&storrs
counsellors at law

William M. Seuch
wseuch@goulstonstorrs.com
(617) 574-4041 Tel
(617) 574-7637 Fax

August 30, 2005

VIA FAX AND OVERNIGHT MAIL

Joseph LeMay
U.S. EPA
1 Congress Street, Suite 1100 (HBO)
Boston, MA 02114

Re: Proposed Cleanup Plan for the Industri-plex Operable Unit 2 Superfund Site (including Wells G&H Operable Unit 3), Woburn, MA

Dear Mr. LeMay:

I am writing on behalf of MetroNorth Business Center, LLC ("MetroNorth"), the owner of a property located adjacent to the long established boundaries of the Industri-plex Superfund Site, to submit comments during the Formal Public Comment Period regarding the above Proposed Cleanup Plan.

MetroNorth is concerned that the U.S. Environmental Protection Agency ("EPA") has not provided property owners adequate time to review the assumptions that underlie the risk assessments leading to the development of the Proposed Cleanup Plan. MetroNorth is also concerned EPA has not appropriately considered all of the facts and circumstances in drafting its Proposed Cleanup Plan, particularly the implications of requiring innocent, downgradient property owners to implement formal institutional controls.

Accordingly, MetroNorth respectfully requests that EPA extend the comment period to allow property owners to obtain professional assistance in reviewing and understanding the data provided by EPA in order to give an informed response regarding the selection of remedies. An extended comment period will also allow EPA and potentially affected property owners to meet and discuss the significant impact the Proposed Cleanup Plan and institutional controls will have on property owners.

1. Property Owners Need More Time to Review the Data

Potentially affected property owners were only recently provided with a large and complicated amount of data that was used to create the assumptions underlying the risk assessments that led to the remedies in the Proposed Cleanup Plan. The information provided is, from a layperson's perspective, voluminous and complex. MetroNorth and other property owners do not have the background and training to understand the data, assumptions or risk assessments. MetroNorth strongly urges EPA to extend the comment period so that MetroNorth can obtain professional guidance to allow it to provide an informed response to the Proposed Cleanup Plan. Without professional assistance, property owners are handicapped by their lack of training and are not able to participate fully in the selection of an appropriate remedy.

2. The Proposed Cleanup Plan Does Not Properly Consider the Interests of Property Owners

The Proposed Cleanup Plan does not properly consider the economic impacts of the proposed institutional controls. The sites subject to the Proposed Cleanup Plan, including MetroNorth's property, were not historically part of the Industri-plex Superfund Site. MetroNorth is concerned that the Proposed Cleanup Plan will create a de facto expansion of the Industri-plex Superfund Site, thereby stigmatizing properties and reducing property values. Naturally, reduced property values will also negatively impact the City of Woburn's tax base.

We cannot underscore the importance of this issue from a property value/economic climate perspective. It is extremely difficult to attract new tenants (including office, R&D, retail, industrial, or others) in the current market and, as a practical matter, requiring potential tenants to consider and address additional environmental issues and the complexities of institutional controls will not be helpful in attracting tenants to the City of Woburn. Based on our experience with properties located within the boundaries of the Superfund Site, the proposed institutional controls will lead to a significant and burdensome increase in administrative, operating, development and transaction costs for downgradient properties that are not sources of contamination. Institutional controls establishing a formal link between these downgradient properties and the Industri-Plex Site will become an environmental due diligence issue requiring input from lawyers and environmental professionals on every side of every transaction each time a property is leased, financed, developed or sold. Prospective tenants may decide to locate elsewhere, on properties without such environmental due diligence issues to understand and manage.

Moreover, we do not believe that EPA has fully considered the costs and challenges of subordinating existing property interests to the proposed institutional controls (particularly where existing lenders and other parties have been secure in the knowledge that these properties are located <u>outside</u> <u>of</u> the Superfund Site). The transfer approval requirements which are set out in the Industri-plex Consent Decree have never applied beyond the boundaries of the Superfund Site.

3. Liability Concerns

MetroNorth is concerned that the institutional controls and de facto expansion of the Industri-plex Superfund Site to include properties that have historically been outside of the Site will expose property owners to liability to the government or existing responsible parties. In order to protect these innocent downgradient property owners, EPA should offer a covenant not to sue and statutory contribution protection as a recognition of the liability burden and exposure any involuntary institutional controls place on these property owners.

4. Inconsistencies with Federal and State Law

The Proposed Cleanup Plan is also inconsistent with both federal and state law and policy. EPA has clearly stated in its "Policy Toward Owners of Property Containing Contaminated Aquifers" that where hazardous substances "have come to be located on or in a property solely as a result of subsurface migration in an aquifer from a source or sources outside the property, EPA will not take enforcement actions against the owner of such property to require the performance of response actions or the payment of response costs." In our opinion, costs associated with implementing and complying with the proposed institutional controls would be "response costs."

The Proposed Cleanup Plan is also inconsistent with state law. Chapter 21E states that a person shall not be liable to the Commonwealth or to any other person where a release of oil or hazardous material has migrated in or on groundwater or surface water from an upgradient source and has come to be located at the downgradient property. See M.G.L. c. 21E, Section 5D. Moreover, Massachusetts law does not require the implementation of environmental deed restrictions where groundwater from an upgradient source property has impacted a so-called "innocent" downgradient property owner. Instead, the downgradient property owner is simply required to file a "Downgradient Property Status Submittal" pursuant to the Massachusetts Contingency Plan. See 310 CMR 40.0180.

5. The Proposed Institutional Controls Lack Full Participation

The proposed institutional controls lack full participation in their creation and raise many questions that need to be properly understood. In fact, no draft institutional controls have been circulated to MetroNorth or other affected property owners or interested parties. MetroNorth is concerned that there has not been enough time to review data, corresponding conclusions or the specifics affecting each property.

One example where lack of full participation is evident is in *Alternative SS-2 (Institutional Controls with Monitoring)* where use of certain properties for day care is prohibited. Many attractive tenants require on-site day care and if there had been full participation in the Proposed Cleanup Plan and Institutional Controls, it would be evident that a blanket prohibition is not necessary. For instance, if a daycare is located inside of a building there is no exposure pathway and such use would be safe for both children and employees. We are aware of many instances where "engineered" playgrounds have been constructed to eliminate potential exposure pathways and allow children to safely play outside at sites with contaminated soil. This example illustrates how a more open and participatory process can create a better Proposed Cleanup Plan.

6. Suggestions for a Better Approach/ Voluntary Cooperation

MetroNorth agrees with EPA's stated goal of achieving "both short-term and long-term protection of human health and the environment" in a "cost-effective" manner. However, we believe this goal can be better achieved through voluntary, rather than unilateral means to achieve specific EPA objectives. Most affected property owners own buildings that are serviced by municipal water and use leases that do not give tenants any rights to withdraw or otherwise use groundwater. It is simply unnecessary to make these landlord/tenant relationships subject to burdensome regulatory requirements.

A voluntary program would also be consistent with the more collaborative approach adopted in recent years under both federal and state Brownfields programs. In the event groundwater contamination poses a potential risk to human health, MetroNorth urges the government to pursue voluntary compliance methods such as voluntary deed restrictions that would prohibit groundwater withdrawal (perhaps modeled on the MADEP's "Activity and Use Limitation" forms that are now familiar to lenders, tenants and environmental professionals). A voluntary approach would lessen the stigma associated with any covered properties, leading to better compliance with the program, higher property values, greatly reduced transaction costs and more tax revenue for the City of Woburn.

7. Conclusion

MetroNorth urges EPA to extend the public comment period to allow for cooperative, and what we believe will be extremely productive, communications with the property owners who will be affected by the proposed institutional controls. Simply put, EPA should take advantage of the real estate expertise of the affected property owners before taking steps to formally extend its enforcement jurisdiction beyond the traditional boundaries of the Industri-plex Superfund Site.

Thank you for your attention to this matter. Please do not hesitate to contact me directly at (617) 574-4041 with any questions or comments

Sincerely,

Bill Seuch

William M. Seuch

cc: Thomas M. Alperin, President, National Development of New England, Inc.
John Beling, Esq., U.S. EPA

goulston&storrs
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Recipient: Mr. Joseph LeMay
U.S. EPA
1 Congress Street
Suite 1100 (HBO)
Boston, MA 02114

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Recipient Phone#:

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counsellors at law

to

name	at	phone #	fax #
Joseph LeMay	U.S. EPA		617-918-1291

cc

name	at	phone #	fax #
Thomas Alperin	National Development of New England	617-527-9292 ext. 5020	617-965-7361
John Beling	U.S. EPA	617-918-1712	617-918-1809

from

name	phone #	fax #	date
Bill Seuch	(617) 574-4041	(617) 574-7637	8/30/2005
5 page(s)		*employee ID* 0479 *client* 02446	*matter* 0018

comments:

fax

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August 30, 2005

VIA FAX AND OVERNIGHT MAIL

Joseph LeMay
U.S. EPA
1 Congress Street, Suite 1100 (HBO)
Boston, MA 02114

Re: Proposed Cleanup Plan for the Industri-plex Operable Unit 2 Superfund Site (including Wells G&H Operable Unit 3), Woburn, MA

Dear Mr. LeMay:

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Accordingly, MetroNorth respectfully requests that EPA extend the comment period to allow property owners to obtain professional assistance in reviewing and understanding the data provided by EPA in order to give an informed response regarding the selection of remedies. An extended comment period will also allow EPA and potentially affected property owners to meet and discuss the significant impact the Proposed Cleanup Plan and institutional controls will have on property owners.

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7. Conclusion

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Thank you for your attention to this matter. Please do not hesitate to contact me directly at (617) 574-4041 with any questions or comments

Sincerely,

Bill Seuch

William M. Seuch

cc: Thomas M. Alperin, President, National Development of New England, Inc.
John Beling, Esq., U.S. EPA

Nutter

Superfund Records Center
SITE: Industri-Plex
BREAK: 4.1
OTHER: 237187

SDMS DocID 237187

Michael A. Leon
Direct Line: 617-439-2815
Fax: 617-310-9815
E-mail: mleon@nutter.com

August 30, 2005

BY HAND

Joseph F. LeMay
Remedial Project Manager
US EPA - New England
One Congress Street, Suite 1100 (mail code: HBO)
Boston, MA 02144-2023

Re: Industri-plex Site, Woburn, MA (the "Site")
Proposed Plan - Second Operable Unit ("OU2")

Dear Mr. LeMay:

I am writing to you on behalf of Atlantic Avenue Associates, Inc., The Welles Company, Aero Realty Trust and Nordraer Realty Trust, all Settlers under the Consent Decree filed in Civil Action Nos. 89-0195-MC and 89-0196-MC (the "Consent Decree"). We have reviewed the correspondence from United States Environmental Protection Agency ("EPA") dated June 30, 2005 and the enclosed Proposed Plan for Operable Unit No. 2 ("OU2") at the Industri-plex Site (the "Site").

As you are no doubt aware, our clients have been involved in the assessment and remediation activities at the site since the mid-1980's, and have been living with the lengthy and sometimes difficult construction activities conducted on and around their respective properties to implement the remedy required by the 1989 Consent Decree. Even now the final certification process for the construction of the cap has yet to be completed, and our clients have had to operate their businesses in the shadow of the superfund stigma, addressing legal issues which arise in the course of financing and working with the interim institutional controls as they continue to operate their businesses. The new Proposed Plan appears to have substantially expanded the boundaries of the existing Industri-plex site to include significant new areas of Woburn, including areas which previously were part of the Wells G and H Superfund Site in Woburn. New work proposed includes in-situ bioremediation of groundwater, periodic sediment dredging, surface water aeration, the construction of new stormwater control structures and a cofferdam in the HBHA pond, as well as new institutional controls, presumably both within and outside the Industri-plex site.

As an initial matter, it is not clear that EPA can propose work of this nature and magnitude, which extends far beyond the designated boundaries of the Industri-plex Site under

CERCLA and the NCP without significant additional administrative procedure. Further, although there has been notice to at least the landowners and Settlers in the Industri-plex Site, and general public notice in Woburn, it is not apparent from the record that all of the property owners and tenants of land potentially affected by the proposed work, and the possible responsibilities associated with it, have been involved in the process as required by CERCLA. These procedural matters should be given appropriate scrutiny to ensure that the requirements of CERCLA are satisfied.

Further, the human health and ecological risk assessments conducted in connection with the proposed work suggest that there is no current human health risk associated with the contamination, and the only potential future health risks appear to be of the type that are customarily managed through the application of Activity and Use Limitations (AUL) or voluntary measures which could avoid the imposition of a CERCLA institutional control under a Consent Decree or Administrative Order, to address exposure to sediments. In addition, although the details of the suggested groundwater institutional controls have not been described, there is nothing to suggest that additional institutional controls are necessary to fulfill the described objectives of the Proposed Plan, at least with respect to groundwater conditions. As the DEP has no doubt explained, under the Massachusetts Contingency Plan (MCP), downgradient property owners are not subject to deed restrictions or other specific recorded controls to address potential exposure risk during the groundwater remediation process. At the Site, it appears that the benzene plume originates from the West Hide Pile area, upgradient of the commercial properties on Atlantic Avenue and Commerce Way. While our clients would consider the implementation of voluntary restrictions on groundwater use during the pendency of groundwater remediation, it does not appear that mandatory institutional controls are necessary to address the existing groundwater conditions on the Site.

It appears from our review of the Proposed Plan that none of the construction work recommended therein will take place on land owned by any of the entities listed above, other than the imposition of institution controls and possible installation of monitoring wells. Moreover, none of these entities are responsible for the historic benzene and arsenic contamination on the Site, which the EPA has previously ascribed to be the possible result of "midnight dumping" when the area was uncontrolled in the 1960's and 1970's . Based on these factors, EPA and DEP should not look to these Settlers for contribution or performance of any work in connection with the proposed remediation.

Very truly yours,

Michael A. Leon

cc: Anna Mayor, MA DEP
John Beling, Esq., US EPA

Nutter

Nutter McClennen & Fish LLP ▪ Attorneys at Law
World Trade Center West ▪ 155 Seaport Boulevard ▪ Boston, MA 02210-2604

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AUG 31 2005

U.S. EPA, Region 1, Mail Room

BY HAND

Joseph F. LeMay
Remedial Project Manager
US EPA - New England
One Congress Street, Suite 1100 (mail code: HBO)
Boston, MA 02144-2023

COMMONWEALTH OF MASSACHUSETTS

MASSACHUSETTS SENATE

STATE HOUSE, BOSTON 02133-1053

SENATOR ROBERT A. HAVERN
ASSISTANT MAJORITY WHIP
4TH MIDDLESEX DISTRICT
ROOM 109D, STATE HOUSE
TEL. 617 722-1432

COMMITTEES:
FEDERAL FINANCIAL ASSISTANCE (CHAIR)
POST AUDIT AND OVERSIGHT
TAXATION

August 31, 2005

Industri-Plex
4.1
237502

Joseph F. LeMay
U.S. Environmental Protection Agency
One Congress Street
Suite 1100 (HBO)
Boston, MA 02114

RE: Public Comments Regarding the EPA Draft Feasibility Study/Proposed Clean-up Plan for the Industri-plex Superfund Site (Operable Unit-2), Including Wells G & H Superfund Site (Operable Unit-3), Woburn, MA

Dear Mr. LeMay:

I am submitting the attached letter of August 22, 2005 into the formal record of public comments for the above-referenced Draft Feasibility Study. Since the EPA is clearly unable or unwilling to respond to my letter in a timely manner (before the agency's own deadline of today, August 31, 2005), I am entering my concerns into the public record, and further requesting that:

(1) EPA immediately grant the City of Woburn reasonable opportunity, including the time and resources, to meaningfully review and comment on the Draft Feasibility Study and a meeting to begin a dialogue with all affected stakeholders; and/or

(2) At a minimum, EPA provide a complete, honest, written response to each of the points outlined in the attached letter.

After working in this community for almost twenty five years, I believe the EPA owes Woburn significantly more than the absolute minimum, but surely the agency would not deny them that.

Sincerely,

ROBERT A. HAVERN, State Senator
Fourth Middlesex District

Cc: Woburn City Councilors:

President Paul Medeiros, Alderman, Ward 5
Alderman Charles E. Doherty, Ward 1
Alderman James E. McSweeney, Ward 2
Alderman Scott D. Galvin, Alderman Ward 3
Alderman William N. Booker, Ward 4
Alderman John A. Ciriello, Ward 6
Alderman Thomas L. McLaughlin, Ward 7
Alderman-at-Large Paul J. Denaro
Alderman-at-Large Joanna Gonsalves

State Representative Jay R. Kaufman
The Honorable John Curran, Mayor, City of Woburn
The Honorable Edward Markey, US House of Representatives
The Honorable Edward Kennedy, US Senate
Aberjona Study Coalition, Inc.
Thomas Alperin – National Development
Dennis Clarke – Cummings Properties
Susan Brand – Cummings Properties
Robert Varney – US EPA – Region I
Daily Times Chronicle
Woburn Advocate

COMMONWEALTH OF MASSACHUSETTS
MASSACHUSETTS SENATE
STATE HOUSE, BOSTON 02133-1053

SENATOR ROBERT A. HAVERN
ASSISTANT MAJORITY WHIP
4TH MIDDLESEX DISTRICT
ROOM 109D, STATE HOUSE
TEL. 617 722-1432

COMMITTEES:
FEDERAL FINANCIAL ASSISTANCE (CHAIR)
POST AUDIT AND OVERSIGHT
TAXATION

August 22, 2005

Robert Varney
Regional Administrator
One Congress Street, Suite 1100
Boston, Massachusetts 02114

RE: EPA's Draft Feasibility Study for Aberjona River (Industri-plex and Wells G&H Federal Superfund Sites)

Dear Mr. Varney:

I am writing to request your immediate and personal assistance in addressing the requests related to the draft Feasibility Study for the Aberjona River (the "Draft FS") set forth in the attached July 21, 2005 letter to you from the Woburn City Council.

The Woburn City Council, the local community group (Aberjona Study Coalition, Inc.) and many other have requested additional time to review the complex clean-up plan proposed by the EPA. Their requests are completely reasonable, particularly considering the lack of any imminent human health threat, at least according to EPA's own studies. Since industry has had over one hundred years to contaminate the river, and EPA has had more than fifteen years to study the river, I am sure you would agree that this community deserves more than sixty days to review the final clean up plan.

Furthermore, as requested in my last letter to you of July 25, 2002, as well as in the attached letter from the Woburn City Council, EPA must ensure that the City of Woburn has the necessary funding and access to the appropriate technical resources needed to assist the City in its review of the Draft FS. In your July 30, 2002 response to the City Council, you agreed to consider their request for external peer review if so requested. Since the EPA-established deadline for public comment is August 31, 2005, I must urge you to move quickly to consider their July 21, 2005 good faith request to you for re-consideration of external peer review. Thank you in advance for honoring your promise in that regard.

Lastly, I would like to re-visit your original commitment to an open, public and transparent process. There appears to be a great deal of apparent confusion about the EPA's proposed plan, a number of requests for more time to look at it and "surprise" (at least based on feedback from some of my constituents) by what EPA has proposed, suggesting that the process and communications are not, in fact, open or transparent. The success of what has been accomplished at the Industri-plex Site is largely the result of collaboration of all three levels of government and the public and private sectors. I must urge you to personally get involved, Mr. Varney, to re-instate the dialogue that was once the cornerstone of what has been and can be accomplished in Woburn, Massachusetts. Perhaps EPA should consider meeting informally with officials from the City of Woburn, the community, major impacted landowners, and other stakeholders. I would be happy to facilitate such a meeting.

Please do not hesitate to call me with any questions. Thank you in advance for your assistance with this matter.

Sincerely,

ROBERT A. HAVERN, State Senator
Fourth Middlesex District

Attachments

Cc: Woburn City Councilors:

President Paul Medeiros, Alderman, Ward 5
Alderman Charles E. Doherty, Ward 1
Alderman James E. McSweeney, Ward 2
Alderman Scott D. Galvin, Alderman Ward 3
Alderman William N. Booker, Ward 4
Alderman John A. Ciriello, Ward 6
Alderman Thomas L. McLaughlin, Ward 7
Alderman-at-Large Paul J. Denaro
Alderman-at-Large Joanna Gonsalves

State Representative Jay R. Kaufman
The Honorable John Curran, Mayor, City of Woburn
The Honorable Edward Markey, US House of Representatives
The Honorable Edward Kennedy, US Senate
Aberjona Study Coalition, Inc.
Thomas Alperin – National Development
Susan Brand – Cummings Properties
Dennis Clarke, CEO Cummings Property

SENATOR ROBERT A. HAVERN
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STATE HOUSE, BOSTON 02133-1053

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Senator Robert A. Havern

Fax

To: Joseph LeMay	**From:** Melissa Murnane
Fax: (617) 918-1291	**Pages:** (including cover sheet) 5
Phone:	**Date:** September 1, 2005
Re:	**CC:**

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● **Comments:**

Thought this might be of interest to you.

SENATOR ROBERT A. HAVERN

ASSISTANT MAJORITY WHIP

4TH MIDDLESEX DISTRICT

ROOM 109D, STATE HOUSE, BOSTON, MA 02133-1053

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ASC

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Woburn MA 01801-1407
www.aberjonastudy.org

(781) 935-2438 email info@aberjonastudy.org

August 31, 2005

Industri-Plex
4.1
237503

Mr. Joseph F. LeMay P.E.
Remedial Project Manager
Suite 1100 (HBO)
1 Congress Street
Boston, MA 02114-2023

Dear Mr. LeMay:

Since April of 2002 we have been associated with the Aberjona River Study. In July of 2002 we invited you and members of your group to speak at the Woburn Neighborhood Association, Inc. meeting regarding this study. It was after that meeting that the idea to form the Aberjona Study Coalition, Inc. (ASC) was conceived.

Over the past forty-one months we have established a coalition consisting of six community groups: Woburn Neighborhood Association, Inc., Woburn Residents Environmental Network, Mystic River Watershed Association, Concerned Citizens Network, Friends of Upper Mystic Lake, and Medford Boat Club that represent over 225,000 residents who border the Aberjona River. Our first task was to hire a technical advisor who is an expert in the relevant environmental sciences and would act as our interpreter to translate the many complex reports that will be issued over the next few years as result of the Aberjona River Study.

The first of the complex Environmental Protection Agency (EPA) reports, "Baseline Human Health and Ecological Risk Assessment Report", was released in two parts during the spring and summer of 2003. This report is the foundation of all of the reports that were to be issued from the EPA over the next few years. If the assumptions are not correct in the baseline report it could have a lasting effect on all of the decisions that will be made. With this in mind when searching for a technical advisor we chose Cambridge Environmental, Inc.

As a joint effort of the Aberjona Study Coalition, Inc. and our technical advisor, Cambridge Environmental, Inc. we submitted thirty-one pages of comments on the Baseline Human Health and Ecological Risk Assessment for Operable Unit 3 of the Wells G & H Superfund Site. We stated in the text, by necessity, that our comments were in part incomplete. We expected to receive and then comment on additional information from the EPA by way of a response to some of the preliminary comments submitted in October of 2003. At that time we also reserved the right to provide further comment to the EPA on issues regarding information that was incomplete.

On June 28, 2004 we received the EPA response to our thirty-one pages of comments to the Baseline Human Health and Ecological Risk Assessment Report. After reviewing the EPA responses we found that many of EPA responses were vague and incomplete. Rather than comment on this release, we decided to wait until the full baseline report for the entire Aberjona Watershed was issued before making any further comments. In our initial review of the Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation, Feasibility Study and Proposed Plan we discovered that some of the comments we submitted in October of 2003 were not satisfactorily addressed by the EPA. Comments that were not adequately addressed included comments on the ecological risk assessments (i.e. a paucity of data collected from each reach and unrealistic exposure estimates for the green heron and mallard). Due to incomplete information, it is difficult to judge the validity of the conclusions of the ecological assessments.

On April 6, 2005 we received the March 2005 report, a 12-volume report titled Draft Final MSGRP Remedial Investigation Report. This report was issued without an EPA comment period. We were told by the EPA that the Feasibility Study would be forth coming and we would have an opportunity to comment on both reports at the same time.

On June 30, 2005 at an EPA public meeting the Proposed Plan Report was distributed to those in attendance. The Remedial Investigation/Feasibility Study, which was supposed to be released prior to the Proposed Plan, was received days later. At this meeting, the public was informed of a thirty-day comment period with a deadline of August 1, 2005. The Aberjona Study Coalition, Inc. publicly requested an extension to the comment period at this meeting of June 30, 2005.

On July 1, 2005 the Aberjona Study Coalition, Inc. submitted a written request to the EPA asking for an extension to the comment period to October 1, 2005. And on July 27, 2005 at an EPA public hearing, the Aberjona Study Coalition, Inc. again requested that the EPA reconsider its decision and extend their comment period.

Through our efforts, and the efforts of United State Senators Edward Kennedy and John Kerry, Congressman Edward Markey, State Representative Patrick Natale, concerned municipal groups and citizens the EPA did extend the comment period to August 31, 2005.

During August of 2005 we again expressed our need to extend the EPA comment period to United State Senators Kennedy and Kerry and Congressman Markey. Senator Kerry and Congressman Markey further forwarded our request to EPA Regional Administrator, Robert W. Varney. Mr. Varney has yet to respond. The Aberjona Study Coalition, Inc. believes that the EPA has put a tremendous and unacceptable burden to review and assess such a complex report within 60 days on the average citizen to whom we represent. We plan to continue to review the reports and provide comments during the next comment period.

Over the past sixty days, as a joint effort the Aberjona Study Coalition, Inc. and our technical advisor Cambridge Environmental, Inc. have spent hundreds of hours reviewing the Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation, Feasibility Study and Proposed Plan. As stated above, on a number of occasions, we have made a formal request to have the comment period extended. Attached is a twenty four-page comment and question document in response to the Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation, Feasibility Study and Proposed Plan. We state by necessity, that our comments are in part incomplete, due to the inadequate comment period. At this time we reserve the right to provide further comments to the EPA on issues that arise after further review of the Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation, Feasibility Study and Proposed Plan Reports.

We believe since the EPA has chosen to meet the least stringent levels of its range of acceptable risks, there is little room for error in the implementation of its plans if the target risk ranges are to be truly met. Every step should be subject to comprehensive evaluations. The proposed plan should be able to stand up to meticulous scrutiny if it is truly valid and all efforts should be made by the EPA to have its work justified and evaluated in a proper and more appropriate timeframe. If the plan goes forward as proposed (or even with minor modifications), the continued process of public participation is crucial to its success. In fact, opportunities for public participation should be intensified.

We recognize the need to present the results of our assessments in simple terms to communicate to the widest fraction of the public as is possible. Yet we bristle when we hear others pronounce absolute judgments of safety such as "there is risk" or "there is no risk". There is always risk. The ASC and other members of the public understand this concept, and oversimplification of it for risk communication purposes obscures the basic meaning of risk.

Thank you for giving us the vehicle in which to voice our comments and concerns. We look forward to your response.

Sincerely,

Linda A. Raymond

Linda A. Raymond, Treasurer
Aberjona Study Coalition, Inc.

Cc:
Senator Edward M. Kennedy
Senator John F. Kerry
Congressman Edward J. Markey
State Representative, Patrick Natale
EPA Regional Administrator, Robert W. Varney
Anna Mayor, DEP Superfund Project Manger
Mayor John C. Curran
Paul Medeiros, President Woburn City Council
Woburn Daily Times Chronicle

Comments on the

Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation
and the
MSGRP Feasibility Study and Proposed Plan
Industri-Plex Site
Woburn, Massachusetts

Prepared on behalf of the

Aberjona Study Coalition, Inc.

by

Stephen Zemba, Richard Lester, and Kyle Satterstrom
Cambridge Environmental Inc.

John Durant
Tufts University

Ronald Gehl
EOS Research, Ltd.

Bonnie Potocki
GZA GeoEnvironmental, Inc.

and

Stephen Smith
GeoHydroCycle, Inc.

August 31, 2005

Introduction and Summary

The Cambridge Environmental Inc. team was selected by the Aberjona Study Coalition (ASC), a stakeholder in the U.S. Environmental Protection Agency's (EPA) investigation of chemical contamination of the Aberjona River, to provide technical assistance in evaluating the results of EPA's work. The ASC represents a broad group of citizens – more than 225,000 residents in Woburn, Winchester, Wilmington, Medford, and Arlington, Massachusetts – who have diverse and long-standing interests in the Aberjona River and surrounding areas. The ASC has three goals with respect to EPA's efforts:

- to ensure that the investigation is technically sound;
- to ensure that the investigation is complete; and, most importantly,
- to ensure that the investigation is adequately protective of human health and the environment.

As representatives of the ASC, the resounding, overarching questions of its members regarding EPA's proposed plan for the Aberjona River are:

1. Is it safe?

2. Will it work?

Like most simple questions, these are difficult to answer. There is no single definition of safety. EPA's Superfund Program defines safety based on the process of risk assessment and works within a flexible risk-based framework to evaluate potential risks to human health and the environment. As pointed out in our previous comments, EPA has chosen to define safety based on the minimum requirements of its program. EPA has the discretionary power to formulate its cleanup plans on different levels of risk. EPA can, if it chooses, promote a plan that attempts to limit incremental cancer risk at a level of one in a million (the most stringent level of its acceptable range) or ten in a million (the target level of the state-level MCP, or Massachusetts Contingency Plan). EPA has, however, chosen the approach of defining acceptable incremental cancer risk to be one hundred in a million, the highest level of the acceptable range of risks within the Superfund program.

Objectively, the target risk level of one hundred in a million is a small risk, one that many people – perhaps even most – consider acceptably small. It still, however, is a risk. It is troublesome, then, that EPA describes safety in purely black-and-white terms. We have witnessed, through diagrams in reports and public presentations, rigid determinations on the part of EPA in defining and communicating safety. Risk and safety are continuum concepts, not binary ones. Within the realm of certainty of risk assessment methods, an incremental cancer risk of ninety in a million is indistinguishable from a risk of one hundred and twenty in a million. Yet EPA calls the former safe and the latter risky as they fall on opposite sides of the bright-line criterion of one hundred in a million.

As risk communicators, we recognize the need to present the results of our assessments in simple terms to communicate to the widest fraction of the public as is possible. Yet we bristle when we hear others pronounce absolute judgments of safety such as "there is risk" or "there is no risk."

There is always risk. The ASC and other members of the public understand this concept, and oversimplification of it for risk communication purposes obscures the basic meaning of risk assessment.

Thus, when presented with the question "Is it safe?", our response is not a simple affirmative or negative, but rather the observation that EPA's plan for the Aberjona River is as safe as it needs to be to meet its risk-based goals. It is not risk free. Per its mandate, EPA has balanced risk and safety with costs and other factors in determining its plan. EPA could choose a plan based on more stringent risk-based criteria, but it does not do so, and from a societal perspective it may not even be wise to do so, as the funds for wider-scale remediation may be better spent in other ways to promote human health and welfare. This point, however, is well beyond the scope of these comments.

There are, in our view, important implications of EPA's proposed plan related to the underlying risk management choices. First, since EPA has chosen to meet the least stringent level of its range of acceptable risks, there is little room for error in the implementation of its plans if the target risk range is to be truly met. Consequently, every step should be subject to comprehensive evaluation and scrutiny. If the plan goes forward as proposed (or even with minor modifications), the continued process of public participation is crucial to its success. In fact, there should be more opportunities for public participation in the remedial design and decision-making process.

Second, EPA's plan must be reconciled with the Massachusetts Contingency Plan (MCP). The MCP's risk-based goals differ in important details, as the maximum allowable cancer risk within the MCP is ten in a million, a level ten times more stringent than the level that underlies EPA's plan for the Aberjona River. Simply put, if the Aberjona River study area was a site under the auspices of the MCP, more of it would probably be remediated to meet its more stringent incremental cancer risk criterion. If the state concurs with EPA's proposed plan, EPA must work with the state to ensure that decisions are implemented fairly and consistently over time. Safeguards, possibly in the form of deed restrictions or binding zoning regulations, are needed to prevent or manage development outside of the assumptions in EPA's risk assessment and to protect private landowners from engaging in costly cleanups of site-related contamination (against their choice) that might be required under the MCP. If EPA decides that deed restrictions are the best means for protecting the public from risk, however, care must be taken to ensure that such deed restrictions do not place an undue financial burden on the community and property owners. EPA should carefully investigate the effect of such deed restrictions on property values prior to requiring them for contaminated properties.

Third, it must be recognized that EPA's plan will leave significant amounts of contamination in place all along the Aberjona River study area. The Aberjona River will not be restored to a pristine environment, but this measure is neither realistic nor justified in the river's urban setting. However, the success of EPA's plan depends strongly on continued risk and land management, not for five years or thirty years, but for perpetuity. Acceptance of the plan on the part of the public is a long-term commitment, and all must be dedicated to bearing the associated costs, responsibilities, and risks.

The success of EPA's plan is directly tied to the second basic question of "Will it work?" Frankly, we cannot tell. Conceptually, the proposed remedy may be successful at containing and managing the source of the contamination at the Industri-Plex site. To our knowledge, however, there are no sites where similar remedies have been implemented. Additionally, success of the plan is tied to the details of its design and performance. EPA has provided almost no detail of its design plans, making it impossible to evaluate whether the remedy will work. Even the most carefully planned designs have unexpected "bugs" when implemented. Given the plan's unique nature, we would think that EPA cannot itself know that it will work. Decisions are always based on imperfect knowledge, and we feel (as detailed in specific comments) that there are areas in which data and information are insufficient to evaluate the technical aspects of EPA's plan. We recognize the need to move forward, however, and in fact support the goal of progress. Implicit in this support is a trust in EPA to protect public health. We expect that implementation of the plan will result in some unexpected findings and consequences. EPA must be prepared to act on unanticipated events and must provide a contingency for dealing with them. Given the uncertainty of the plan in terms of its unique nature and lack of specified detail, the allowance for contingency should be substantial.

Monitoring is a fundamental and crucial aspect of EPA's proposed plan. Adequate monitoring is the only way to determine that the remedy is working as designed, and it is of heightened importance in this case given the novelty of the remedy and the intention to contain, rather than remove, the source of the contamination. Several elements of the proposed plan call for monitoring. Since EPA has provided essentially no details on the monitoring that will be performed, it is impossible to gauge whether plans are sufficient to determine with confidence that the remedy is working. The mode of contaminant transport that EPA has identified – groundwater discharge followed by surface water transport, especially during storm events – is a difficult pathway to monitor. Since EPA has developed cost estimates for monitoring, it presumably has detailed information (number of samples, analytes, frequency of samples, locations of samples, event-based sampling plans, etc.) that has not been documented. Given its importance in ensuring the success of EPA's proposed plan, this detailed information on monitoring should have been made available for comment. Since details have not been provided at this point, we trust that EPA has allowed for sufficient monitoring, and we anticipate the ability to review and comment on EPA's monitoring plans at some point in the future.

Some other relevant questions raised by ASC members that we cannot answer bear consideration, including:

- *Does EPA have a backup plan? What if the proposed plan doesn't work? How can the EPA be certain that the methods that they are now proposing will be effective in the future?* Presumably, the five-year review process will address the ongoing adequacy of the remedy, but there is a need to provide more detail on the specific ways that EPA will evaluate the performance of the remedy to ensure the public that there is a plan in place, and that if things go wrong there are specific means and actions that can take place to fix problems.

- *Who is going to oversee the future building on properties and adhere to rules and regulations? What rules and regulations will be in place for this?* Given that risk management is an essential part of the remedy, plans for deed restrictions, zoning regulations, and other measures should be detailed to inform the public and ensure them that public health will be protected. These plans are especially important in areas outside the delineation of the two Superfund sites.

- *The EPA report suggests that the contamination can be stopped at the HBHA. Is this process a tried and true process? If not, when and how will this be revisited in the future if it doesn't work?* These questions emphasize previous points. If EPA is aware of similar remedies, it would be useful to share information on them to provide assurance to the public that the proposed plan is likely to succeed.

- *Winchester residents are very concerned over many flooding issues in their community. Why did the EPA perform no testing in these areas that ASC commented on?* And *what has EPA done to evaluate whether the proposed remedy will increase flooding downstream?* Given that transport during storm events is the primary mechanism of contaminant dispersal that has been identified by EPA, we concur with the ASC that the issue of flooding deserves greater attention than it has received, as detailed in further technical comments.

- *Who is going to oversee the capping and the construction? The City of Woburn? Who is going to be responsible for giving permits for construction on these sites? Is the City of Woburn responsible in any way?* These concerns speak to the public's desire to maintain local control and input during the implementation of the remedy. EPA should perhaps meet with stakeholders to inform them of their roles and responsibilities during the cleanup process.

Public trust in EPA hinges on continued cooperation and openness on the part of EPA in providing meaningful opportunities for input and participation. The flurry of activities that serve as the subject of these comments is an example of inadequate allowance for public participation. We suspect that EPA has met all of its statutory and regulatory requirements for meetings, notices, and comments, but has in reality left most interested parties far behind in their wake of reports and information. Response to the most recent public hearing held on July 29, 2005 serves as an excellent example of EPA's insufficient allowance for public input. The number of comments made at the meeting was not large, which could be incorrectly interpreted as a general lack of interest. Rather, the sparseness of comments was due more to the fact that the public is overwhelmed by the amount of information that has been issued by EPA and the lack of time allowed to comprehend it in any meaningful way. Almost every comment included a request for additional time to review EPA's reports and plans. Moreover, the temporal overlap of the comment period with summer vacations has made it difficult to coordinate meetings, staff, and review. As technical reviewers to the ASC, we have barely scratched the surface of the available material. Normally, the amount of information provided by EPA would be issued in a series of reports, with opportunity for comment on each. It is true that some of the information in the Aberjona River Study has been presented in earlier reports associated with the two Superfund site investigations, but many people (ourselves included) have only recently become involved with EPA's investigation and must "get up to speed" to understand the context of the current work.

EPA has invited comments on its MSGRP RI/FS report and its proposed plan. We are also providing comments on EPA's September 2004 update to the Baseline Human Health and Ecological Risk Assessment Report. It contains significant amounts of new information critical to EPA's determination of significant risks, and hence the adequacy of the proposed cleanup plan. Since EPA has not previously accepted comments on the new material in this report, and this information is critical to EPA's risk-based conclusions that underlie its proposed plan, we feel it is essential that EPA consider these comments. We also reserve the right to provide additional unsolicited comments to EPA on its proposed plan as we maintain that insufficient time has been allowed for review and comment.

Some of the comments we submitted in October 2003 were not satisfactorily addressed by EPA in the September 2004 and MSGRP risk assessments. Comments that were not adequately addressed, including a number of comments on the ecological risk assessments, are repeated herein. Due to a number of inadequacies in the ecological risk assessments (including, for example, a paucity of data collected from each reach and unrealistic exposure estimates for the green heron and mallard), it is difficult to judge the validity of the conclusions of the ecological assessments.

Comments on the September 2004 Human Health and Ecological Risk Characterization (Metcalf & Eddy, 2004)

The residential exposure pathway in the September 2004 update to the Baseline Human Health and Ecological Risk Assessment Report and the data needed to support this pathway remain insufficient

In response to our previous comments, EPA included an evaluation of residential exposure to contaminants in soil as part of its updated September 2004 risk assessment. Part of this evaluation included the collection of a limited number of surface soil samples at the AJRW location in Winchester, an area within the delineated floodplain of the Aberjona River. Interestingly, the average arsenic concentration detected in the floodplain surface soils (46 mg/kg) exceeds the concentration found in shoreline sediments (22 mg/kg, p. 2-63). Since – at the single location EPA chose to actually sample soils – EPA finds a soil concentration of arsenic that exceeds its corresponding sediment concentration, it clearly suggests that EPA must do additional soil sampling, particularly at locations we recommended in previous comments that represent actual exposure points not covered in EPA's sampling (*e.g.*, residences south of sampling location 08 that appear to have yards that intrude into the current 100-year flood plain delineation, and the bike trail that runs north from Davidson Park, past the International Family Church property).

EPA evaluates the residential exposure pathway at five locations along the Aberjona River (WS/WSS, CB-05, KF, 07/DP, and AJRW). Actual surface soil data are only available at one of these five locations (AJRW, as described above). The other four stations rely on data from near shore sediments. Lacking actual surface soil data from relevant locations, EPA's conclusions regarding potential risks from the residential exposure pathway are uncertain, especially since (as stated above) the one instance surface soil was collected (AJRW), it was found to contain more arsenic than the corresponding shoreline sediment. If shoreline sediment concentrations underestimate surface soil concentrations, risk estimates generated for the WS/WSS, CB-05, KF, and 07/DP locations could be underestimated. The lack of data simply makes it impossible to know for certain. The failure to collect sufficient data in upland soil areas subject to flooding remains a potentially serious uncertainty in the risk assessment that makes it difficult to support EPA's conclusion of no significant risk with respect to the residential exposure pathway.

Moreover, the fate-and-transport pathway to get arsenic into surface soils is complete and supported by EPA's conceptual model of contaminant migration. EPA believes that arsenic is getting transported down river from the Industri-Plex site during storm events. Storm events cause flooding, and the additional scouring of stream banks can add to contaminant loads originating from the Industri-Plex site, producing turbid waters in inundated areas. Suspended materials in the water can settle, depositing arsenic to surface soils in the flooded areas.

The risk calculations for the residential pathway are inconsistent and risks are significant if EPA considers all of the data it presents

In addition, the additional tables and calculations presented by EPA in the September 2004 update to the Baseline Human Health and Ecological Risk Assessment Report are not consistent and suggest potential omissions. Table 3-3.4 lists the exposure point concentrations used in the calculations. Problematically, the sampling locations listed in Table 3-3.4 differ from those mentioned in the text of the report and subsequent tables. The sampling locations included in Table 3-3.4 are NR, WS/WSS, CB-05, DA, KF, and 07/DP. Page ES-3 and other places in the report claim that the residential calculations were performed for locations WS/WSS, CB-05, KF, 07/DP, and AJRW. Thus, the NR and DA locations in Table 3-3.4 were not used in subsequent tables and calculations, and the AJRW location (the only one that represents actual soil data) was evaluated instead (though not included in the exposure point concentration Table 3-3.4). Coincidentally, stations NR and DA have the highest exposure point concentrations among the stations in Table 3-3.4, each having a reasonable maximum exposure (RME) point concentration of 200 mg/kg for arsenic. If these locations are considered in risk calculations similar to those of the other sampling locations, the resulting risk estimates are greater than the upper limit of the U.S. EPA's acceptable risk criteria. Table 1 illustrates this point. Taking the ratios of risk to exposure point concentrations for the four locations that overlap between EPA's Table 3-3.4 and Tables 3.9-100 to 3.9-104 and extrapolating them to the exposure point concentrations for stations NR and DA in Table 3-3.4 results in incremental cancer risk estimates of 200 in a million (twice EPA's safe level) and hazard indices of 4 (four times EPA's safe level).

Table 1 Risk estimates for the residential pathway extrapolated to omitted stations

Sampling location	Table 3-3.4 RME exposure point concentration for arsenic (As) (mg/kg)	Incremental cancer risk estimate from Tables 3-9.100 to 3-9.104 (per million)	Hazard index (HI) estimate from Tables 3-9.100 to 3-9.104	Cancer risk to As EPC (risk per mg/kg)	HI to As EPC (risk per mg/kg)	Extrapolated incremental cancer risk (per million)	Extrapolated hazard index
NR	200					200	4
WS/WSS	10	10	0.2	1.00	0.020		
CB-05	60	70	1	1.17	0.017		
DA	200					200	4
KF	46	50	0.9	1.09	0.020		
07/DP	45	50	0.9	1.11	0.020		
AJRW		70	1				
		Average risk to concentration ratio		1.09	0.019		

Apparently, EPA initially intended to consider locations NR and DA in its calculations but later decided to omit them. Given that the risk estimates for these stations exceed EPA's acceptable risk management criteria, the omission is curious. Examination of the locations of NR and DA on the aerial photograph of Figure 2-1 suggests that NR is located in a commercial zone, which may explain its elimination from the residential analysis (although, in the absence of deed restrictions, residential redevelopment of this location might be possible). Station DA, however, appears actually to be located in the general vicinity of residential areas. The discrepancy in sampling stations between Tables 3-3.4 and Tables 3-9.100 to 3-9.104 demands explanation, as the conclusions of the risk assessment are potentially quite different if stations NR and DA are considered. Moreover, stations NR and DA indicate that there are locations with elevated concentrations of arsenic that could lead to significant risks. Tables 3-3.2 and 3-3.3 indicate numerous other sediment-sampling stations with exposure point concentrations greater than 100 mg/kg (the approximate level that corresponds to significant risks per EPA's calculations), which suggests the potential for other surface soils to exceed significant risk criteria (especially if, as the singular AJRW station indicates, surface soils may contain more arsenic than the sediment).

Target-specific hazard index estimation is incomplete and underestimates potential health risks; calculations should consider secondary health endpoints

In many cases, EPA evaluates target-specific hazard indices to gauge the significance of non-cancer health risks. Each chemical is assigned to a specific category of potential adverse health impacts based on the nature of the toxicity data used to derive its reference dose (safe exposure level). However, the target-specific analyses incorrectly assume that each chemical has one and only one endpoint via which it can cause adverse health impacts. In some cases, chemicals can cause multiple adverse health effects at different levels of exposure. In cases where the aggregate hazard index (summed over all chemicals) exceeds one and EPA has developed target-aggregate hazard index (summed over all chemicals) exceeds one and EPA has developed target-specific analyses for which the disaggregated hazard indices are all smaller than one, EPA should evaluate secondary endpoints for chemicals that might contribute risk to the critical health endpoint. For example, Table 3-9.100 of the September 2004 update to the *Baseline Human Health and Ecological Risk Assessment Report* lists a target-specific hazard index of 0.9 for arsenic based on potential adverse health effects to skin. None of the other eight chemicals of concern have skin as their critical target organ, but may nevertheless affect the skin at higher levels. If all of the other eight chemicals caused adverse effects on skin at ¼ the effectiveness of their target organs, their hypothetical contribution to the overall skin hazard index would be 0.3, and combined with arsenic would exceed the target hazard index of one. By not considering the potential effects of chemicals on non-target organs, EPA has underestimated potential risks.

New information is available about flood plains and should be included in the assessment

The new Mystic River watershed flood plain study conducted by ENSR for FEMA (completed recently) indicates increased flooding in the Aberjona River compared to the old flood maps. The old flood maps were created about 20 years ago. Since then, there has been much new development in the watershed that would increase flooding. There have also been improvements in techniques for modeling flooding. Thus, the new data are far more accurate and should be considered in your analysis, particularly when examining the risks associated with the flood plains in Winchester.

EPA does not take into account the possible ecological impact of deep sediment contamination

As we commented in October 2003 (Zemba *et al.*, 2003), in the 2003 Baseline Ecological Risk Assessment (BERA), EPA did not justify its decision not to sample sediment depths lower than 6 inches. In the current BERA, this problem has continued. In Appendix E.4 – Baseline Ecological Risk Assessment Supplemental Data of the Baseline Human Health and Ecological Risk Assessment Report – concentrations of Contaminants of Potential Concern (COPCs) from 1-2 foot, 2-3 foot and 3-4 foot were not presented nor discussed in the text. The concern of re-suspension of deep sediments that may be contaminated was not addressed. Deeper contamination in sediments may exist beyond Reach 1, but the data have not been provided. Additionally, no remediation is proposed beyond Reach 0. Risk management actions, such as land use restrictions, could be taken to prevent scouring and erosion of contaminated deeper sediments.

The exposure model used for the Green Heron is not representative of its exposure

The exposure model used for the Green Heron (Metcalf & Eddy, 2004; pages 4-55 to 4-56) does not accurately estimate its exposure. Because herons seek favorable foraging areas and do not wander far, exposures should be expressed by reach rather than site-wide. Their foraging areas can be small – for example, a shoreline of a wetland or along a wetland channel; yet, small fish data collected site-wide were used to estimate that fish represent 45% of a heron's diet. Because a value of 55% was used in the exposure model for the invertebrate proportion of a heron's diet, more crayfish data should be collected from reaches not sampled (see Davis and Kushlan, 1994).

The exposure model used for the muskrat is not representative of its exposure

Because muskrat exposures and risks were calculated on a station-by-station basis (page 4-57), the same comments regarding the Green Heron and the inadequate crayfish data also apply to muskrats.

The number of crayfish collected from various reaches is quite limited

As we commented in October 2003 (Zemba *et al.*, 2003), only two samples were collected from reaches 1 and 2, three from reach 3, one from reach 5, and no samples at all from reaches 4 and 6. These are extremely small crayfish datasets for reaches that measure at least 100 feet each in length. In Table 2-179, the average arsenic concentration in crayfish was 2.7 mg/kg in reach 2, 1.5 mg/kg in reach 3, and 0.24 mg/kg in reach 5. This latter value was the arsenic concentration in a single crayfish. Additionally, the average concentration of contaminants in crayfish is used to assess risk in each reach. Although this provides a best estimate of risk, due to the limited nature of the data, it would be more conservative and more protective of the environment to use the maximum detected concentrations.

Although no crayfish samples were collected from reaches 4 and 6, dietary exposures associated with ingestion of crayfish were calculated for these areas using data from reaches 3 and 5. Using crayfish body burden data from another reach to represent potential crayfish body burdens in reaches 4 and 6 does not provide useful information that can aid in making a risk management decision.

Plant uptake factors derived in one reach should not have been applied to all reaches

As commented in October 2003 (Zemba *et al.*, 2003), plant uptake factors based on a small number of plant samples were applied to plants in all areas considered in the ecological risk assessment. Six plant samples were collected from stations in the 38-acre wetland of reach 1. Plant tissue data are not available for the other 5 reaches. Using average plant uptake values derived from another reach to represent potential plant tissue concentrations for the other five reaches will not provide useful information that can aid in making a risk management decision.

Evaluating potential dietary and food-chain risks should involve sampling the part of the plant actually eaten

As commented in October 2003 (Zemba *et al.*, 2003), although the EPA collected media-specific data for the ecological risk assessment, EPA did not necessarily collect the most appropriate data. For example, in evaluating potential dietary risks to the muskrat, EPA sampled cattails, the muskrat's primary food item. Instead of sampling the roots and basal portions of the plants eaten by muskrats (as stated on page 4-38), however, EPA sampled the stems and leaves of the cattails.

Plant tissue concentrations for muskrats should be measured, not modeled

Exposure COPC doses for plant ingestion (page 4-58) should not be modeled for the muskrat because the risk assessment should represent realistic and site-specific exposures. The use of plant tissue concentrations that were modeled from average station sediment COPC concentrations for each habitat (pond, wetland, or river) multiplied by site-wide uptake factors is appropriate for a screening-level assessment, but not a baseline risk assessment.

Eels should be included in the BERA

As commented in October 2003 (Zemba *et al.*, 2003), eels were caught in the fish survey but were not used in the Risk Assessment. Though eels are a key species in the study area, no justification is provided for the exclusion of eels from the study. Eels have a higher lipid content than the white sucker, a species that was considered in the study, and could therefore contain higher concentrations of lipophilic chemicals. The eel should replace the white sucker in the Risk Assessment. Eels should additionally be used in the small fish tissue data used to calculate dietary fish exposure for the heron.

Metals could be responsible for adverse effects to benthic invertebrates

Copper could be responsible for adverse health effects in benthic invertebrates and perhaps fish as well. The average concentration of 49.7 mg/kg in crayfish is approximately twice the laboratory test concentration at which no effects were observed (page 4-72). The on-site tissue concentration of copper was 2.5 times higher than the reference samples.

Additionally, evaluation of sediment chemistry indicated that high concentrations of arsenic, copper, chromium, mercury, and zinc were correlated with both (a) those sites with evidence of reduced growth of benthic invertebrates in toxicity tests, as well as (b) those stations with evidence of impacted natural communities (page 4-85).

Arsenic Toxicity Reference Value (TRV) discrepancy for muskrat

The text (page 4-88) appears to be incorrect or the calculations are incorrect for the risks to the muskrat. The text states that a test TRV for arsenic is based on a chronic (reproductive) lowest observed adverse effect level (LOAEL) in a mouse of 1.93 mg/kg-day, but a test TRV value of 1.26 mg/kg-day appears in Table 4-142.

In addition, the text states that the "TRV is based on oral doses of sodium arsenite which is likely to be more toxic than forms found in the muskrat diet on-site. Due to these uncertainties, the confidence in the conclusion of risk to muskrat is reduced." However, 3.3 % of the diet is associated with ingestion of sediment, either in the pond or wetlands, which may be in arsenite form.

The derived Wildlife TRV value for chromium is not the most conservative value

The derived Wildlife TRV value of 7 mg/kg-day for chromium (page 4-89) does not appear to be the most conservative value. A test TRV of 5 mg/kg-day for a mouse is listed in Table E.3.1 and represents a reproductive endpoint. Using this value, a wildlife TRV would be 2 mg/kg-day and would be a more reasonable estimate to use for the muskrat. It is likely that chromium could be a risk driver for the muskrat because the 3-fold difference between the two wildlife TRVs would elevate the hazard index by a factor of 3.

EPA's conclusion that there is no evidence of negative impacts on the survival, growth, or reproduction of green heron populations or other piscivorous birds resulting from the exposure to COPCs in the study area (page 4-92) is flawed

EPA's conclusion may be inaccurate for the following reasons:

- Exposure calculations do not adequately reflect realistic exposures for green herons.
- Table 4-251 indicates that the average arsenic concentration of 0.3 mg/kg in blue gills for the study area is 3-fold higher than the reference, but the concentrations detected in each reach are not presented.
- Table E.2-2 shows that arsenic concentrations in brown bullhead tissue are significantly greater than the reference concentrations.
    - The average arsenic concentration of 0.14 mg/kg in brown bullhead fillets from Reach 3 was 3-fold higher than the reference concentration of 0.042 mg/kg.
    - The average arsenic concentration of 1.2 mg/kg in brown bullhead offal from Reach 3 was 27-fold larger than the reference concentration of 0.046 mg/kg.
    - The average arsenic concentration of 0.17 mg/kg in brown bullhead fillets from Reach 6 was 4-fold higher than the reference concentration.
    - The average arsenic concentration of 0.096 mg/g in brown bullhead offal from Reach 6 showed a 2-fold increase relative to the reference.

In addition, differences in COPC concentrations in crayfish, small fish, and bottom feeding fish within reaches should be compared because risk management decisions will need to be made by reach. Some areas may not be suitable for aquaculture.

EPA is incorrect in concluding that "there is relatively high confidence in the mallard TRV used for arsenic since it is based on the same species for a chronic exposure" (page 4-93)

The test TRV of 5.14 mg/kg-day for arsenic selected for the mallard and heron was derived from a mortality endpoint, not a chronic endpoint such as reproduction or growth. A lower test TRV of 3 mg/kg-day is cited in Table E.3.2 and is from a recent study (Camardese et al., 1990).

It is a flawed rationale to conclude, "The exposure analysis indicates that a portion of the potential mallard habitat may be impacted within the Wells G&H 38 acre wetland. However, the limited area of arsenic above 1,000 mg/kg is not sufficient to represent a threat to mallard populations within the wetland, even if the ducks limited foraging to this wetland exclusively." The exposure and risk model for the mallard only examines the exposure and risks to the adults, not fledglings which limit their foraging to the immediate vicinity of the nest. If fledglings from the nests in the Wells G&H 38 acre wetland don't survive due to the effects caused by arsenic, this could have a dramatic effect on the local mallard population.

Feathers could easily be collected from nests in nearby heron colonies or mallard nests in the HBHA wetlands or the Wells G&H wetland, and they could subsequently be analyzed for arsenic to assess their exposure and risk.

Exposure parameters for the mallard should be re-examined

As commented in October 2003 (Zemba *et al.*, 2003), only sediment samples beneath less than three feet of water were used to evaluate exposure of mallard ducks to sediment. The justification and references for this threshold should be elucidated. Also, many species of ducks live on Mystic Lake for at least a portion of the year. Because it is the largest open water body in the Aberjona River watershed, exposures for mallards in Mystic Lake should be calculated separately. Sediment sampling location SD-02-01 was used to evaluate exposure of a muskrat to sediment, but was not used to evaluate mallard exposure.

There is too much uncertainty surrounding shrew conclusions

EPA may be incorrect to state that "the survival or reproduction of shrew may be impaired in the study area due to exposure to inorganics in diet, but the results are associated with moderate level of uncertainty" (page 4-96). A screening level risk assessment was performed for the shrew, not a baseline risk assessment that uses site-specific dietary data. Because earthworms were not collected, there is high degree of uncertainty with associated risk estimates. More accurate risk estimates to small mammals such as shrews are desirable because shrews can be found in areas similar to those frequented by pets that roam into the drier wetland areas. In addition, Figure 4-37, Comparison of Arsenic in Sediment to Ecological Thresholds, shows that 7 areas/locations in Reach 2 exceed the shrew threshold and muskrat threshold.

Fish community health should be an ecological measurement endpoint

As we commented in October 2003 (Zemba *et al.*, 2003), because benchmarks are not available for some chemicals of concern and because the ecological effects of exceeding the benchmarks are not well defined, another measurement endpoint should be used to evaluate the potential effect of chemicals on the fish populations in the Aberjona River and Mystic Lake. This endpoint should be an assessment of the fish community to evaluate the biological integrity of the Aberjona River.

One such endpoint could be the Index of Biotic Integrity, which is an aggregation of 12 biological metrics that are based on the fish community's taxonomic and trophic composition and the abundance and condition of fish. These metrics assess the species richness component of diversity and the health of resident taxonomic groupings and habitat guilds of fish. Two of the metrics assess the community composition in terms of tolerant or intolerant species. Fish protocols are described in U.S. EPA (1999).

EPA's conclusion (Page 4-98) that "the assessment did not indicate any impacts on the local populations of predatory fish, bottom feeding fish, and small foraging fish populations" is flawed

The evaluation does not directly address the ecological effects of COPCs but merely compares tissue concentration to tissue residue benchmarks. An evaluation of the age structure of a fish population for each of the different feeding classes would be indicated if existing fish populations have been affected.

Comments on the Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation Report (Tetra Tech, 2005)

Bedrock was not adequately assessed

When attempting to drill 50 feet into bedrock to establish a sampling/monitoring point, three out of four attempted wells failed. Why are no data from the successful well presented in the MSGRP report? Bedrock is a potential contaminant pathway that has not been adequately addressed.

The horizontal extent of the investigation should have included the Olin Chemical site in Wilmington, Massachusetts

Documents concerning the Olin Chemical site reveal that soils in the area between the Northern Remedial Investigation (RI) Study Area and the Olin Chemical site are conductive sands. Groundwater flow contours prepared by Olin's consultants show flow directions to the south, toward the Northern RI Study Area. Olin also emphasizes the bedrock issue by being on record as having significant pools of dense non-aqueous phase liquid that could migrate in bedrock. Inclusion of the Olin Chemical site in the RI should be considered due diligence.

Comments on the MSGRP Human Health and Ecological Risk Assessments

The drinking water pathway should be explicitly considered in the risk assessment; depending upon assumptions, health risks from the drinking water pathway could exceed target risk levels

The drinking water ingestion pathway should be explicitly considered in the risk assessment. At present, the MSGRP report contains considerable discussion of the possibility that groundwater contamination from the Industri-Plex site might migrate further south and affect water quality in the areas of Woburn Wells G&H, especially since the wells may be used again as a source of drinking water. Meeting federal Maximum Contaminant Levels (MCLs) is indeed a relevant requirement of Superfund remedies, but meeting the MCLs is not a substitute for the quantification of potential health risks. This is an important consideration for arsenic. A 70 kg adult who ingests 2 liters of water per day containing arsenic at its MCL concentration of 10 μg/l for a period of thirty years (standard risk assessment assumptions) incurs an incremental cancer risk of 200 in a million (assuming the standard cancer potency of 1.5 kg-d/mg and a lifetime length of 70 years). The estimated risk is even greater if a portion of the thirty-year period is assumed to include childhood (as is typically done in Superfund risk calculations). Simply put, drinking water that contains arsenic at its MCL constitutes a significant risk under the guise of the Superfund program, even if it does not violate the MCL standards of the Safe Drinking Water Act.

The Industri-Plex site has affected groundwater quality in wells located in the Interim Wellhead Protection Area (IWPA) of wells G&H. EPA found that 11 of 23 wells in the IWPA contained arsenic concentrations in excess of the federal Maximum Contaminant Levels (MCLs) that public water systems must meet to protect human health. Based on this finding alone, a permanent remedial solution could not be established for the site within the context of the MCP, which would demand that GW-1 groundwater standards (equivalent to MCLs for the chemicals for which they are established) be met. The technical memorandum provided by EPA to support the assumption that MCLs would not be exceeded at the Wells G&H wellheads contains significant uncertainties that are not sufficiently supported by data. The memorandum asserts (p. viii) that "the above summarized information are the major lines of evidence suggesting limited potential to mobilize dissolved arsenic to a production well under pumping conditions." Given that, under non-pumping conditions, arsenic is already migrating toward the wells at concentrations exceeding its MCL, it appears to in fact be quite mobile, and the qualitative lines of evidence provided in the technical memorandum are not sufficient to evaluate the migration potential of arsenic. A weight of evidence evaluation does not serve as a substitute for actual data. EPA should design a test program to confirm the various qualitative assumptions of the technical memorandum. Moreover, simply meeting the MCLs is not a demonstration of no significant risk. The rudimentary risk calculations above illustrate that levels lower than the MCL are sufficient to constitute a significant risk to human health (per EPA's, and especially the Massachusetts DEP's, target risk criteria).

Last, the issue of whether the MCL for arsenic is safe is a debatable issue. Technically, water from the G&H could be used if it contained arsenic concentrations just below the MCL of 10 μg/l. The arsenic MCL, however, is in part based on natural levels of arsenic that exist in groundwater in various parts of the country. EPA has allowed the MCL to correspond to a substantial risk to avoid treating tremendous quantities of naturally contaminated groundwater. Groundwater at Wells G&H, however, has very low levels of natural arsenic, and arsenic from the Industri-Plex site – should it reach these wells – represents contamination from a manmade release. Risks associated with this contamination should therefore be considered outside of the context of the MCL.

Comments on risk assessment uncertainty summary

MSGRP pg. 6-10 ascribes considerable uncertainties associated with some exposure point concentrations that are influenced by highly variable data. The precise purpose of using an upper confidence limit on the mean is to account for such uncertainty, which typically results from insufficient numbers of samples to characterize the data distribution. Default risk assessment techniques substitute the maximum detected concentrations within reasonable maximum exposure calculations in cases in which upper confidence limits exceed the maximum values. In these situations, EPA should conduct sensitivity calculations on the risk estimates based on the upper confidence limits (even though they would be higher than the maximum concentrations). If the risk estimates of the sensitivity estimates exceed risk management criteria, EPA should consider further sampling in these areas to better characterize exposure point concentrations and reduce uncertainties.

Additionally, examples of singularly high concentrations such as the 1,600 mg/kg detected at location SC02 suggest the presence of "hot spots" that, if contacted even on occasion, might present excessive risks to human health. EPA should evaluate the potential need for the evaluation of health risks due to acute or short-term exposures. The ATSDR has established an acute Minimum Risk Level (MRL) of 0.005 mg/kg-d for arsenic. A 70 kg dredger ingesting an elevated level of 500 mg/kg per day of soil with an arsenic concentration of 1,600 mg/kg would receive a daily dose of 0.01 mg/kg-d, a value twice the acute MRL. EPA should evaluate acute exposure levels of potential concerns and consider the need for appropriate measures to protect individuals (such as dredgers) against short-term hazards.

The car wash scenario is likely a conservative estimate of the degree of exposure that a worker might receive from exposure to volatile chemicals emanating from groundwater used as industrial process water. As noted on p. 6-10 of the MSGRP, other groundwater use scenarios might be associated with much lower risk. As constructed, the risk assessment provides only the car wash scenario as a basis for developing potential restrictions on groundwater use. We suggest that additional scenarios be added to the risk assessment to provide a broader basis for determining guidelines for using groundwater for industrial or commercial (or other non-contact) uses.

The risk assessment is appropriate in considering former Mishawum Lake bed soil cores in the risk assessment

Although current exposure to buried sediment from the former Mishawum Lake bottom is unlikely, it is necessary to consider future use of these areas. EPA appropriately sampled these soils and included the data in the risk assessment.

The risk assessment does not address ammonia despite the presence of an applicable or relevant and appropriate requirement (ARAR)

Responding to a question at a public meeting in which EPA presented the findings of its MSGRP report, EPA stated that ammonia is not a chemical of concern in the ecological risk assessment, despite the fact that it has been detected at extremely high levels in both groundwater and surface water. Ford (2005) and Cutrofello (2005), in fact, report ammonia levels in groundwater entering the north basin and in the bottom waters of the north basin exceeding 500 mg/l. EPA has, however, published an entire document updating the ambient water quality criterion for ammonia (U.S. EPA, 1999). The freshwater chronic criterion for ammonia depends on pH, but varies from about 4 mg/l to about 0.2 mg/l for pHs from 6 to 9. A further description of the ammonia AWQC is available at http://www.epa.gov/waterscience/criteria/ammonia/technical.html. The AWQC is illustrated in Figure 1 (extracted directly from EPA's technical description). Since (1) AWQCs are Applicable and/or Relevant and Appropriate Standards for surface water streams and (2) ammonia is a contaminant demonstrably associated with the Industri-Plex groundwater plume, ammonia should be explicitly considered as a contaminant of concern in the ecological risk characterization.

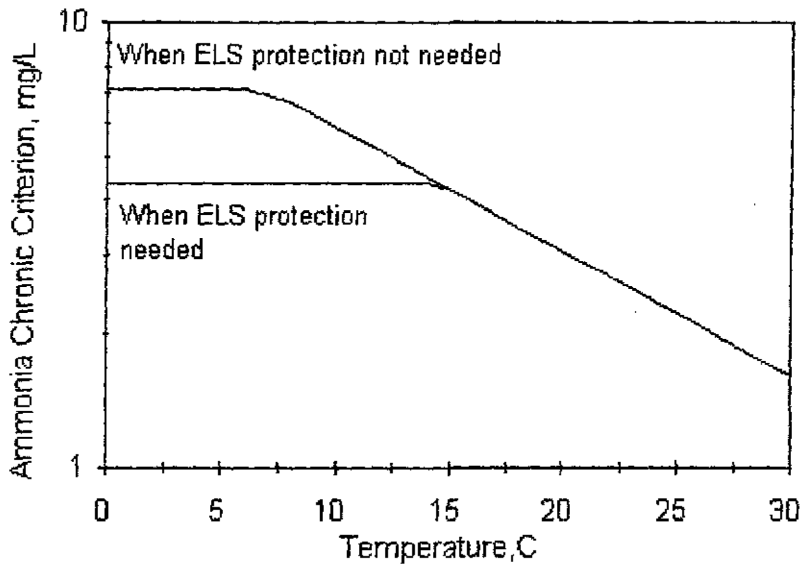

Figure 1 Example Ambient Water Quality Criteria for ammonia (pH 7.5)

There is still too much uncertainty surrounding shrew conclusions

As in the September 2004 ecological risk assessment, there is still much uncertainty in the shrew calculations. EPA concludes that there are "Uncertain population effects," and EPA has made no effort to reduce the uncertainty. No remediation is proposed in Reach 2 but risks are moderate. Risk management such as land use restrictions should be created to prevent scouring and erosion of contaminated sediments and further migration downstream.

Plant uptake factors derived in one reach should not be applied to all reaches

Plant tissue samples were collected in reach 0 and reach 1 (pages 7-12). In the southern study area, a site-specific uptake factor was applied to the sediment concentration to estimate a plant tissue dose. Emergent plants were not collected from reaches 2, 3, or 4. Thus the same comments cited for the Baseline Risk Assessment also apply to this report.

Arsenic is detected above reference criteria

We disagree with the statement on Page 7-4, "The resulting level of ecological risk for the receptors is low except for the benthic invertebrates in the HBHA Pond." Arsenic frequently is detected above reference criteria in areas other than the HBHA Pond.

EPA incorrectly concludes that the impact on the muskrat population is not considered an unacceptable ecological risk

EPA concludes that the impact on the muskrat population is not considered an unacceptable ecological risk. EPA's rationale is as follows (pages 7-13 to 7-14):

> Muskrat have been observed in the study areas, but this fact alone does not conclusively prove the level of the effect on the population, as these individuals may have inhabited only the less contaminated areas, or may have represented recruitment from adjacent habitats. Population studies were not conducted on site for mammals... based on the data collected, the risk assessment does not provide sufficient evidence to conclude that arsenic contamination in the study areas is causing an adverse effect on muskrat populations that is of sufficient magnitude, severity, and extent that the population will not be maintained in an acceptable state.

Conversely, because no population measurements were taken, one could state that the risk assessment does not provide sufficient evidence to conclude that arsenic contamination in the study areas *is not causing* an adverse effect on muskrat populations. The density of individual muskrats in the HBHA wetlands and 38-acre wetland was not measured. This measurement would be beneficial to estimate the frequency of muskrat use as well as the habitat value to the muskrat. In addition, if individual muskrats were captured, their fur could be analyzed for arsenic to determine if exposure to arsenic had occurred.

Comments on the Feasibility Study and Proposed Plan

Arsenic that has migrated down river from the Industri-Plex site may trigger state regulatory requirements even if deemed insignificant by EPA

The concentrations of arsenic detected in surface soil at the AJRW location would present a significant risk under the Massachusetts Contingency Plan (MCP). Since the concentrations exceed the MCP's background concentration, the data would need to be reported as a release. Calculation of cancer risk estimates in excess of 10 in a million would demand remedial action under the MCP, even though they are within the range allowable under the Superfund program. Since the Massachusetts Department of Environmental Protection is likely to concur with the findings of EPA's determination of acceptable risk (which is permissible within its discretionary authority), significant areas of contamination will not be remediated under EPA's plan that would fail the risk-based criteria of the MCP. This is not to say that EPA's risk management criteria are not protective of human health, but only that the MCP attempts to be more protective than EPA's proposed plan.

A potentially larger problem involves actions that might occur after the EPA completes its cleanup. Individual landowners along the Aberjona River could potentially rediscover the contamination not remediated by EPA and be required to clean it up at their own expense under the MCP. The arsenic concentrations detected in surface soils at the AJRW location, for example, would require reporting under the MCP, and would likely require remediation to meet the MCP's allowable incremental cancer risk limit of 10 in a million. For consistency, if EPA determines that areas meet acceptable risk limits (and therefore do not require remediation), and DEP concurs with this finding, then some mechanism must be put in place to protect landowners from potential remedial actions under the MCP. Normally, deed restrictions (in the form of Activity and Use Limitations under the MCP) would be used for this purpose. Deed restrictions may not be practical for all reaches of the Aberjona River. Some mechanism, however, should be put in place as part of EPA's plans (*e.g.*, provisions within town bylaws to restrict development within the Aberjona River floodplain).

Additionally, areas flooded by the Aberjona River extend well beyond the current 100-year flood plain delineation, which is widely known to be out of date. Significant flow restrictions on the river have changed its flooding characteristics, and these characteristics may change again if (as proposed) communities such as Winchester take measures to mitigate flooding. The definition of the study area should be modified to reflect the latest available flood plain delineation, even if in draft form (assuming federal agencies cooperate with each other, EPA should be able to get draft delineations from FEMA). Coincidence of the study area with the flood plain is important because it represents the area potentially affected by contamination from the Industri-Plex site. Even should EPA choose not to conduct additional sampling (which we consider inadequate), knowledge of the study area might be important to future landowners should they discover elevated levels of arsenic and other site-related contaminants at their properties. As described above, levels of arsenic in soil that EPA considers safe under any conditions (per their risk criteria) trigger reporting and investigation requirements under the MCP.

Alternative HBHA-4 involves significant physical disturbance of the Halls Brook Holding Area (HBHA) pond, which raises a concern about whether the existing chemical stratification and the predominant redox chemistry of the pond can be maintained

The Natural Attenuation Study (Ford, 2004) provides a conceptual model for the geochemical mechanisms at work in the pond environment, outlining a relatively complex suite of reactions between groundwater that discharges to the pond and the water of the pond itself. There is uncertainty as to which reactions control the sequestering and release of arsenic in particular, although monitoring data seem to support the presence of a relatively stable chemical environment, as long as stormwater impacts are not too great. It is possible that large-scale disturbance of the pond during and after implementation of the construction and dredging measures proposed in HBHA-4 could also upset the balance of reactions currently taking place to limit the discharge of contaminants from the pond. If this alternative is implemented, measures must be designed to prevent turnover of the chemocline as a result of construction work. At a minimum, frequent and careful monitoring of principal water quality parameters and the redox chemistry in the pond must be undertaken during implementation to ensure that favorable conditions for the sequestering of arsenic are not upset.

The Proposed Plan suggests that EPA's proposed Alternative GW-2 for groundwater, when combined with HBHA-4, "also controls the downstream migration of contaminated groundwater by intercepting it at the northern portion of the HBHA pond" – however, the cofferdam will not intercept arsenic in groundwater discharging directly to the south basin.

Sampling data from certain groundwater monitoring points installed near the northeastern shore of the HBHA pond indicate high concentrations of arsenic and benzene at depths that are below the elevation of the bottom of the pond. This suggests that there may be a component of groundwater flow that results in the discharge of contaminants to the sediment bed in the pond further south than is currently expected. Dredging of sediments from the downstream side of the cofferdam structure proposed for the pond will certainly alter or eliminate existing sequestering mechanisms for contaminants in the southern portion of the HBHA pond. Therefore, it is necessary to determine whether groundwater discharge to the sediment bed in central portions of the southern half of the pond is occurring.

Additionally, as observed by Ford (2004), the arsenic discharge zone in the HBHA pond extends from "the mid-point of the northern bank down to approximately the north exterior wall of the 36 Cabot Road Building." However, as depicted in Figure 4-3 of the Feasibility Study (TetraTech, 2005), the eastern end of the cofferdam will be ~100 ft to the north of the north exterior wall of the 36 Cabot Road Building. This means that groundwater contaminated with high levels of arsenic discharging to the south basin through this 100-ft-zone will not be intercepted by the cofferdam. This could lead to the buildup of high levels of arsenic in the sediments and bottom waters of the south basin. Ford (2004) observed that arsenic in the sediments of the south basin ranged from 420-1500 mg/kg and that the maximum levels of dissolved arsenic in the central and south areas of the pond ranged from <1-3 mg/L. These levels exceed the preliminary remediation goals (PRGs) for arsenic in sediment (300 mg/kg) and surface waters (150 ug/L). Thus, even if surface sediments in the south basin are dredged – as called for in the Proposed Plan (Alternative HBHA-4) – arsenic in groundwater entering the south basin to the south of the cofferdam could, over time, accumulate in the sediments and bottom waters of the south basin to levels in excess of the PRGs.

EPA should amend the Proposed Plan by requiring interception of the arsenic plume entering the south basin in the groundwater recharge zone between the east end of the proposed cofferdam and the north exterior wall of the 36 Cabot Road building. At minimum, additional installation of monitoring points and sampling of groundwater beneath the pond should be conducted, and the cofferdam and dredging design must be modified accordingly should results suggest discharge further south than anticipated.

The proposed remedial plan does not address high concentrations of dissolved total ammonia (NH_4^+ plus NH_3) entering the north basin in groundwater

Ford (2005) and Cutrofello (2005) reported that ammonia levels in groundwater entering the north basin and in the bottom waters of the north basin can exceed 500 mg N/L [note: Ford (2005) reported ammonia concentrations as "NH_3-N," which we interpret to mean total ammonia (NH_4^+ plus NH_3)]. These levels are very high for surface waters. While not listed as a contaminant of concern for the Industri-Plex site, high levels of dissolved total ammonia may impact the effectiveness of the proposed aeration system for treating arsenic. The aeration system will be located between the two cofferdams and will treat water coming over the first cofferdam before it discharges over the second cofferdam and into the south basin. The goal of the aeration is to "serve as a polishing treatment… to further encourage precipitation of dissolved arsenic and… further improve water quality by increasing dissolved oxygen" (Tetra Tech, 2005). In the presence of sufficient oxygen, arsenite will be oxidized to arsenate, and co-occurring dissolved ferrous iron will be oxidized to form particulate hydrous ferric oxide (HFO), which is highly sorptive for arsenate. However, ammonia in the north basin surface waters will compete for available oxygen as ammonia is converted to nitrate (nitrification). If the ammonia levels are high enough, the rates of ferrous iron and arsenite oxidation may be greatly reduced.

In designing the aeration system to provide sufficient oxygen "to further encourage precipitation of dissolved arsenic," EPA should carefully consider the complex chemistry of the north basin surface waters. Modeling, possibly accompanied by jar tests, is required to properly assess the impacts of high levels of reductants – ammonia, ferrous iron, arsenite, and sulfide – as they compete for oxygen in the aeration of the north basin surface waters.

The Feasibility Study does not describe the plans for reducing risks posed by the sediments and chemolimnion in the north basin after the PRGs for GW-2 have been reached

If the treatment system for groundwater (GW-2) works according to the description in the Feasibility Study (TetraTech, 2005), arsenic levels in groundwater entering the north basin will eventually be below the groundwater PRG of 150 ug/L, and the cofferdam will no longer be required. However, once the groundwater arsenic PRG is met, arsenic levels in the sediments of the north basin will still be significantly elevated above the PRGs for sediment (300 ppm). Likewise, as long as the chemocline persists, dissolved arsenic levels will likely remain well above the surface water PRG (150 ug/L). Ford (2004) reported that arsenic levels in sediments of the north basin are currently >300 ppm from the sediment-water interface (0 cm to ~10 cm), and that levels tend to be highest (as high as 1,500 ppm) in surface sediments (0 to 6 cm). Ford (2004) also reported that dissolved arsenic levels in the north basin are as high as 6 mg/L, which is 40-fold higher than the PRG. Thus, as long as high levels of arsenic remain in the surface sediments and the bottom waters of the north basin are anoxic, arsenic will be present in the chemolimnion in a form that can be readily transported downstream in significant amounts. This has important implications for the design and maintenance of Alternative HBHA-4.

Before the cofferdams are removed from HBHA, EPA should make provisions for reducing the arsenic levels in the chemocline and the sediments of the north basin to levels that are below the surface water and sediment PRGs.

The justification for the 30-year design-life of the chemolimnion/retention pond system has not been provided in the Feasibility Study.

In the absence of this information it is impossible to judge the feasibility of the Proposed Plan with regard to cost. All of the costs provided in the Feasibility Study are based on a 30-year design-life for the chemolimnion/retention pond system; however, because of the large amounts of arsenic in the waste piles from which the plumes are emanating and the low groundwater velocities, it is possible that elevated arsenic levels will continue to be transported into HBHA for more than 30 years. Aurilio et al. (1995) estimated that there were ~270 metric tons of waste arsenic deposited on the Industri-Plex site. In an earlier study, Aurilio et al (1994) estimated that ~190 g/d of arsenic are entering the northern end HBHA pond in groundwater. Assuming that only 10% of the waste arsenic on the Industri-Plex site can be mobilized and transported in groundwater to HBHA pond, it would take nearly 400 years for all of this arsenic to reach the pond. While there is uncertainty in these simple estimates, the 10-fold difference between the design-life of the chemolimnion/retention pond system and the period of arsenic leaching strongly suggests that the design-life estimates should be reviewed.

EPA should revise the Feasibility Study to fully explain how the 30-year design-life for the chemolimnion/retention pond system was determined. This explanation should include a discussion of the mass balance calculations used to size and estimate the design-life of the chemolimnion/retention pond system. EPA should then allow public comment on these revisions to the Feasibility Study.

Estimates of the volume of contaminated sediment to be removed in proposed Alternative NS-4 are based on the analyses of a very limited number of samples

A carefully considered plan for more accurate delineation of contaminant concentrations in sediment should be implemented during the removal process to ensure that all areas above PRGs are excavated.

Regardless of which alternative is implemented for surface water, automated sampling stations should be established at several locations for ongoing monitoring of remedial progress

To provide alerts of adverse flow conditions that could result in contaminant release, wireless transmitters similar to those employed during the Remedial Investigation should be employed to rapidly direct monitoring personnel to appropriate areas for emergency response, if necessary.

Does the design of the storm water bypass (Section 3.4.5.1) consider dense storm water during cold weather?

Under the Proposed Plan, during storms some fraction of the storm water would flow into the north basin, and the remainder would be diverted to the south basin. At many times of the year storm water will be colder than the oxic layer in the north basin (e.g., during the summer). Because the colder storm water will be denser than the oxic surfaces layer, storm water would sink and displace oxic waters, thereby potentially causing storm water to mix with and flush anoxic waters over the cofferdam. Is this considered in the design?

The Proposed Plan calls for construction of cofferdams constructed of "driven inter-locked sheet piling" – how will the piling material standup to ice on the north and south basins during the winter? (Section 3.4.5.2)

EPA should require that the cofferdams be designed to withstand the effects of ice.

Sediment Retention Area at Northern Portion of the HBHA Pond: on page 3-31, paragraph 1 of the Feasibility Study (Section 3.4.5.2) it is written that "construction of baffles/flow deflectors or installation of floating silt curtains around which surface water flow would be directed, resulting in lower flow velocities as surface water moves toward the southern end of the pond."

This statement is not correct. Since $Q_{in} = Q_{out}$ in the north basin, flow velocities around baffles and curtains will increase. Travel distances (and hence hydraulic residence times) will increase, which may enhance particle settling, but velocities will not be reduced. Two related questions: (1) what size particles will be removed by the proposed retention basin, and (2) what are the hydraulic residence and particle settling times in the north basin? Because the answers to these questions will impact the effectiveness of the retention basin to remove particulate arsenic, in the absence of this data it is not possible to judge the feasibility of the proposed retention basin to meet the PRG for surface water flowing to the south basin.

Sediment Retention Area at Northern Portion of the HBHA Pond: by not allowing chemolimnion to spill over from the north basin to the south, the volume of the chemolimnion will increase, and the chemolimnion level will rise up in the north basin impacting more of the pond

This will cause greater volumes of anoxic water to build up and potentially adversely impact more of the benthic community in the north basin than is currently impacted. EPA should address this question in the Proposed Plan and require that additional alternative habitat be created.

How will the frequency of sediment dredging be determined?

On page 3-31, paragraph 3, sentence 4: how will the frequency of sediment dredging be determined? Also, will the sediment dredging require that the north basin first be dewatered? If so, this could have significant impacts on the design of the sediment dredging plan as there may be large volumes of contaminated water produced during the dewatering process. Where will this water go? Will it be treated? If so, how and where? EPA should address these questions in the Feasibility Study.

It is unclear whether the aeration system in the area between the two cofferdams will further encourage precipitation of dissolved arsenic

On page 3-31, paragraph 4 it is written that the area between the two cofferdams would contain an aeration system to "further encourage precipitation of dissolved arsenic." It is not clear if this will be effective. The water will contain very high levels of ammonia, sulfides, and reduced iron, which will all compete with arsenic for oxygen. It is likely that advanced oxidation process – e.g., UV-peroxide oxidation – will be required to effectively oxidize the arsenic moving downstream from the first cofferdam to the second. Also, it is not clear if the aeration system will be operated all year long or if it will be shut off periodically (e.g., during the winter months). Lastly, it is written that "Periodically, the secondary sediment retention area may also require dredging," but it is not clear how the frequency of dredging will be determined. EPA should address these questions in the Feasibility Study.

EPA does not adequately describe the long-term monitoring and maintenance program for Alternative HBHA-4 (Section 3.4.5.5)

A significant part of Alternative HBHA-4 is the long-term monitoring and maintenance program; however, this program is not adequately described to allow judgment of its feasibility. On page 3-33 of the Feasibility Study it is written that the program will include "regular surface water monitoring of the chemocline/retention pond, periodic bathymetric surveys of the sediment surface and comparison to an as-built survey, and periodic dredging to maintain the as-built conditions." This statement is lacking in specificity. In particular, how often would the surface waters be monitored, and what would be measured? What metrics will be used to determine when dredging is needed? Will monitoring be done during dredging to determine downstream transport of resuspended sediments? Will surface water monitoring be done before, during, and after significant storm events (e.g., 20-yr storm event) to determine whether arsenic is being flushed from the north basin and whether the surface water PRGs are being met?

EPA should clearly specify in the Feasibility Study when and where monitoring would be done and what parameters would be measured. EPA should specify in the Feasibility Study what actions will be taken if the monitoring reveals that the PRGs are not being met.

The proposed plan includes institutional controls on groundwater

The Massachusetts Contingency Plan specifies that groundwater aquifers are considered State resources and its foreseeable use is therefore determined by the State, not by individual property owners (DEP, 1995). Institutional controls, therefore, cannot be placed on groundwater unless the State designates these groundwater areas as inappropriate for the uses that pose risk in the human health risk characterization.

EPA should correct a few minor errors in the report

Section 3.4.5.2 (Sediment Retention Area at Northern Portion of the HBHA Pond), on page 3-31, paragraph 2, describes "construction of a dual low-head cofferdam system starting at the approximate location of the mouth of the Halls Brook and continuing west across HBHA Pond... with the northern portion serving as the sediment retention and secondary polishing area." It should be noted that Hall Brook enters HBHA on the western shore; thus, if the cofferdam is constructed from the brook outlet across the pond, construction will proceed to the east and not the west.

Page 3-31, paragraph 3, makes reference to "diffusion from accumulated sediments and subsequent chemocline precipitation." It is not clear what is meant by these statements and what they refer to. It appears that this phrase was inadvertently appended to the sentence in which it appeared.

On page 3-31, paragraph 3, sentence 3, it is not clear how the sediment storage figure of "2,000 yd^3 of in-place sediment per vertical foot" is arrived at. Is this an estimate arrived at from carefully performed measurements and calculations, or is this simply a rough estimate? EPA should describe how the sediment storage volume was estimated.

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To Joe Lemay/R1/USEPA/US@EPA
cc Angela Bonarrigo/R1/USEPA/US@EPA
bcc
Subject ASC Comments - MSGRP and Feasibility Study and Proposed Plan

8/31/05
Mr. LeMay:

Attached is a cover letter and comments from the Aberjona Study Coalition, Inc. on the Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation and the MSGRP Feasibility Study and Proposed Plan Industri-Plex Site Woburn, MA

The signed letter and document was sent to you by US Mail today.

Linda A. Raymond, Treasurer

Aberjona Study Coalition, Inc. August 31 - Final Cover Letter.doc FinalMSGRPRIFSPlan8-31-05.doc

Massachusetts Bay Transportation Authority

Mitt Romney *Governor* | *Kerry Healey* *Lt. Governor* | *John Cogliano* *Secretary and MBTA Chairman* | *Daniel A. Grabauskas* *General Manager*

SDMS DocID 237506

August 31, 2005

Via Email and Certified Mail, Return Receipt Requested

Joseph F. LeMay, Remedial Project Manager
US EPA – New England
One Congress Street, Suite 1100 (Mail Code: HBO)
Boston, MA 02114-2023

Industri-plex
4.1
237506

Re: **Proposed Plan – Industi-plex Superfund Site - Operable Unit 2, Woburn , MA**

Dear Mr. LeMay:

In June 2005, the United States Environmental Protection Agency ("EPA") issued a Proposed Plan ("Plan") for the cleanup of Industri-plex Superfund Site Operable Unit 2 (including Wells G&H Operable Unit 3). The Plan was developed to address soil, sediment, groundwater, and surface water contamination. Additionally, the Multiple Source Groundwater Response Plan Remedial Investigation Report ("RI Report") issued March 2005, and the Draft Final Feasibility Study ("Feasibility Study") issued in the June 2005, were referenced as supplemental documentation in the Plan.

EPA has granted stakeholders an extension of time to August 31, 2005 to comment on the Proposed Plan. In this letter, the Massachusetts Bay Transportation Authority ("MBTA") provides its comments on the Proposed Plan, especially the preferred alternative remediation measure for Halls Brook Holding Area ("HBHA") Pond Sediments, which is identified in the Plan as "Alternative HBHA-4".

- **The MBTA's is a Potentially Interested Party, and not a Potentially Responsible Party**

Although the MBTA owns part of Operable Unit 2 (excluding Wells G&H Operable Unit 3), the MBTA only used its property as a railroad Right-of-Way ("ROW"), which is part of the Lowell Commuter Rail Line. Its operations were limited to trains passing along its ROW. Therefore, it was not an operator on Operable Unit 2 (including Wells G&H Operable Unit 3), either in general or in terms of CERCLA liability.

Without admitting any liability under CERCLA or any other theory for Operable Unit 2 (including Wells G&H Operable Unit 3), the MBTA acknowledges it has some current ownership interests in part of the land in Operable Unit 2 (excluding Wells G&H Operable Unit 3) that makes it a "Potentially Interested Party" with concerns about the remedial measures to be implemented to clean up Operable Unit 2.

Since the MBTA's operations were minimal on Operable Unit 2 (excluding Wells G&H Operable Unit 3) and did not contribute to the soil, sediment, groundwater and surface water contamination on Operable Unit 2 (including Wells G&H Operable Unit 3), the MBTA believes it should not be considered a "Potentially Responsible Party" for the purposes of CERCLA and/or Superfund liability. The MBTA is essentially an innocent landowner. It believes other parties should share in the costs to perform the preferred alternative remedies for cleaning up the contamination of Operable Unit 2 (including Wells G&H Operable Unit 3).

Finally, the MBTA is a public entity. It has limited control over its funding, and currently faces a multi-million deficit. These reasons also support it having a no financial responsibility for the cleanup cost.

- **Proposed Cap along the Northern Portion of the Halls Brook Holding Area Pond**

The RI Report (page 4-16) refers to 30 inches of cover materials ("the cap") that were placed over soils containing contaminants in excess of the 1986 EPA established action levels: arsenic (300 ppm), chromium (1,000 ppm), and lead (600 ppm). However, a 16-inch cap (4 inches of topsoil and 12 inches of cover soil with a non-woven geotextile marker barrier) is being proposed along the northern portion of the HBHA Pond, as part of Alternative HBHA-4, to cap contaminated soils with arsenic levels as high as 744 mg/kg. Our comments/questions are as follows:

  - Why is a 16-inch cap being proposed for elevated metal levels?
  - Please provide the rationale for using a relatively thin soil cap.
  - Please provide the rationale for only placing 4 inches of topsoil on the cap being proposed as part of Alternative HBHA-4. This is a relatively thin topsoil layer. It will require significant monitoring and maintenance to prevent erosion damage.
  - Please provide the report reference that describes the cap monitoring and maintenance program(s). It is critical that the cap be maintained to eliminate migration of contaminants.
  - Page 5-10 of the RI Report indicates that the MBTA ROW was not capped; however, Figure 4-1b indicates that the MBTA ROW was capped. According to our records, the MBTA ROW was capped.

- **The Proposed High Density Polyethylene Liner for the streambed west of the MBTA railroad tracks**

A component of Alternative HBHA-4 requires the lining of a portion of the streambed located west of the MBTA railroad tracks with a 40-mil High Density Polyethylene (HDPE) Liner overlain with a 16-inch thick layer of gravel/cobble. Our comments/questions are as follows:

- Please provide the flooding criteria that were considered to assess stream levels during storm events.
- Has the EPA considered the potential for structural damage to the railroad tracks, along with the potential for contaminated stormwater to discharge to the ROW?
- Please show the location of the streambed and proposed limit of work in relation to the MBTA ROW, and explain why only a portion of the streambed is being lined.
- If Alternative HBHA-4 is implemented, a geotextile cushion should be provided between the HDPE liner and the gravel cobble, to help prevent damage and punctures to the liner, which could be caused by the gravel/cobble layer.

- **Proposed stormwater bypass structure followed by a sediment retention area in the northern portion of the HBHA Pond**

Alternative HBHA-4 includes the construction of a stormwater bypass structure followed by a sediment retention area in the northern portion of the HBHA Pond. The Feasibility Study explains that the purpose of the stormwater by-pass system is to divert storm flow from Halls Brook to avoid high flow volumes into the proposed sediment retention area that would break down the chemocline. Our comments/questions are as follows:

- Please explain how contaminated sediments that will enter the southern portion of the HBHA Pond via the stormwater by-pass structure during storm events will be managed. The Feasibility Study indicates that sediment will be periodically dredged from the sediment retention area, but it is not clear if periodic dredging is also proposed in the southern portions of the HBHA Pond.
- Please explain how the chemo-cline will be maintained in the southern portion of the HBHA Pond during and following storm events. As indicated on page E-6 of the Feasibility Study, the chemo-cline is destabilized during storm events and the amount of metals entering the water column and being transported further downstream is much greater.
- Please provide the flooding criteria that are being considered for the implementation of Alternative HBHA-4.
- What precautions are being taken to help ensure that contaminated stormwater does not discharge to the MBTA ROW?
- What precautions are being taken to help ensure that stormwater flooding will not cause structural damage to the railroad tracks?
- Please provide details regarding the proposed dredging work, which will demonstrate that this activity will not cause structural damage to the MBTA railroad tracks and/or ROW.

- **Proposed Institutional Controls for Soils and Sediments**

EPA is proposing institutional controls with monitoring for the preferred cleanup alternatives for soils (RAs SS-2 and SUB-2) and sediments (RA DS-2). Our comments/questions are as follows:

  - Please provide the details of the proposed institutional controls and monitoring program.
  - Please provide the report reference, which will allow us to better understand the following:

    - Will access to contaminated areas be limited by fencing, and if so, where is fencing proposed?
    - What areas will be monitored?
    - What is the proposed monitoring program (i.e., contaminant parameters/media to be monitored and the monitoring frequency)?

- **Contaminated Groundwater and Surface Water**

As indicated in the RI Report, contaminated groundwater and possibly surface water is present within the MBTA ROW. To facilitate the protection of worker health and safety during maintenance activities within the MBTA ROW, we have the following comment:

  - Please provide the report reference that indicates the depth to groundwater and location of contaminated surface water (if any) within the MBTA ROW.

- **Design of Preferred Alternatives**

We understand that EPA has only studied the feasibility of each cleanup alternative and will need to produce design documents for each preferred alternative. Our comment is as follows:

  - Please provide a complete set of design documents for each of the preferred alternatives when completed because we would like to review them and provide comments.

- **Conclusion**

The Massachusetts Bay Transportation Authority submits this letter to comment on the Proposed Plan for the cleanup of Industri-plex Superfund Site Operable Unit 2 (including Wells G&H Operable Unit 3). This letter and comments are made without waiver of any applicable defenses to liability under CERCLA or any other applicable theory of liability, and all such defenses are hereby explicitly preserved. Nothing in this letter is intended to be, and should not be construed by any party for any purpose to be, an admission for any purpose, including but not limited to an admission of liability under CERCLA.

On behalf of the MBTA, I look forward to working with EPA on these important issues at the Industri-plex Superfund Site. If you have any questions or concerns about the content of this letter, please contact me at 617.222.3174 or sdarling@mbta.com.

Very truly yours,

Scott Darling, III
Environmental Counsel

cc: William Mitchell, Esq., MBTA; Dennis DiZoligo, MBTA; Debra Darby, MBTA; Janis Kearney, Esq., MBTA; Andrew Brennan, MBTA; Mary Ellen Boyle, Esq. MBTA; Prasanta Bhunia, W&S;

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08/31/2005 04:13 PM

To Joe Lemay/R1/USEPA/US@EPA
cc
bcc
Subject Industri-plex - Operable Unit 2

Mr. LeMay,

Attached are the comments from the MBTA on the Proposed Plan for the Industri-plex Superfund Site, Operable Unit 2 (including Wells G&H, Operable Unit 3). You will receive the actual letter in the mail. If you have any questions, please do not hesitate to call me at 617.222.3174.

scott d.

LeMay Industriplex superfund.pdf

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August 31, 2005

Mr. Joseph F. LeMay, P.E.
US EPA
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RE: Comments on the Industri-Plex Proposed Remedy
***ENSR Project Number* 06250-134-0006**

Dear Mr. LeMay

At the request of DEK Portfolio Limited Partnership (DEK), ENSR has performed a review of the Federal Environmental Protection Agency's (EPA) Proposed Cleanup Plan for the Industri-Plex Superfund Site Operable Unit 2 (OU-2). The primary focus of ENSR's review was to evaluate the effects of the proposed clean up plan on the DEK properties located at 32 and 36 Cabot Road in Woburn, Massachusetts. The 245 acre Industri-Plex Site abuts the DEK properties to the north. Based on our review of the Proposed Cleanup approach, it appears that portions of the DEK property would be affected by the following Cleanup Plan elements: imposed institutional controls (restricted land usage), storm water bypass, pond dredging, sediment retention construction activities, long term groundwater and sedimentation monitoring, and periodic retention pond maintenance dredging operations.

DEK's two primary concerns relative to the proposed plan are as follows:

- Alternative GW-2-Pond Intercept with Monitoring and Institutional Controls within the Halls Brook Holding Area (HBHA) is essentially a passive remediation technique that will utilize the pond's existing dynamics to sequester contaminants in the northern portion of the HBHA and is in reality a component of sediment remedial alternative HBHA-4 which is designed to prevent continued downstream migration of arsenic-impacted sediment within the Aberjona River basin. Since it is essentially a passive method there will be limited effects/impacts to the subject property from implementation of this alternative alone. However, this remedy does not address the source of the contamination to groundwater entering the DEK property and discharging to the HBHA from the Industri-Plex site to the north. EPA plans to implement in-situ remediation (proposed groundwater remedy GW-4) in the West Hide Pile Area of the Industri-Plex site. It is ENSR's opinion that treatment or control of the source of the groundwater contamination upgradient of the HBHA should also be included to reduce offsite plume concentrations. The GW-2 remedy does not actually remediate groundwater at the site and Applicable or Relevant and Appropriate Requirements (ARARs) are not met until the point of compliance specified in the Draft Final Feasibility Study, which is at the discharge point of the cofferdam structures installed within the HBHA as part of sediment remedy HBHA-4. Therefore, with the exception of the institutional control and monitoring components, proposed alternative GW-2 is not effectively different from alternative GW-1, No Action. A reactive barrier installed as part of proposed remedy GW-4 along the NStar Easement to the north of the DEK property should be re-considered to protect the DEK property, the HBHA and the downstream sediments in the Aberjona River in the long term, while still retaining remedy GW-2 combined with sediment remedy HBHA-4 to eliminate downstream migration of arsenic bearing sediment in the short term. Concerns relative to proposed remedy HBHA-4 are discussed below.

- Implementation of Alternative HBHA-4-Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternative Habitat directly affects the DEK properties. The alternative includes construction of the sheet pile cofferdam and aeration zone, the dredging and dewatering of ~6,200 cubic yards of sediment from the southern portion of the HBHA Pond, capping and stabilizing the soils adjacent to the NSTAR and MBTA rights of way with permeable cap, and construction of the storm flow bypass structure. At this time, based on the information available, we can not fully evaluate or provide comment on the actual impacts to the current and/or future users of the DEK properties from construction and O&M until the final design, installation, and maintenance procedure for this proposed alternative are developed. As discussed above in our comments to proposed remedy GW-2, if groundwater impact to the HBHA could be eliminated through upgradient treatment or control of the plume through installation of a reactive barrier as part of remedial alternative GW-4, then the long term impacts of operation and maintenance of HBHA-4 could also be eliminated.

On behalf of DEK Portfolio LP, ENSR thanks you for the opportunity to provide comment on the Proposed Plan for remediation of the Industri-Plex Superfund Site and we applaud your efforts to move the remedy forward.

Sincerely,

Lawrence M. Hogan, PG, LSP, LEP
Program Manager

cc: Heather O'Donnell- DEK Portfolio
J. Lerner- Lerner & Holmes

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To Joe Lemay/R1/USEPA/US@EPA

cc Heather_O'Donnell@spauldslye.com, "Joel D. Lerner" <jlerner@lh-law.com>, Paul_Sampson@spauldslye.com, rkazazian@gpinvestors.com

bcc

Subject Industri-Plex Proposed Remedy Comments

Dear Mr. LeMay:

On behalf of DEK Portfolio Limited Partnership, owner of the properties located at 32 and 36 Cabot Road in Woburn, Massachusetts, we are providing the attached document containing comments to the EPA's Proposed Plan for remediation of the Industri-Plex Superfund Site Operable Unit 2. Hard copy is also being sent by US Mail postmarked today.

Thank You,

Lawrence M. Hogan, PG, LSP
Program Manager

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August 31, 2005

Industri-Plex
4.1
237509

By facsimile and first-class mail
Mr. Joseph LeMay
U.S. Environmental Protection Agency
One Congress Street, Suite 1100 (HBO)
Boston, MA 02114

Subject: RTC Realty Trust Comments
Proposed Cleanup Plan for the Industri-plex Operable Unit 2

Dear Joe;

The RTC Realty Trust (the "RTC") has reviewed Environmental Protection Agency's ("EPA") Proposed Cleanup Plan for the Industri-plex Superfund Site, Operable Unit 2, and including Wells G&H Superfund Site, Operable Unit 3, Aberjona River Study, Woburn, Massachusetts and has the following comments.

The proposed alternative (HBHA-4) has the potential to significantly alter the surface flow regime in the area of HBHA. More study or explanation is needed to address the potential for flooding as a result of altering the surface flow. Please demonstrate that the proposed cofferdams and bypass structure will not increase the potential for flooding of properties north of the HBHA and/or flooding of downstream properties.

One of EPA presentations mentions that high storm flows into the HBHA "break down the chemo cline, stir up the bottom sediments, and "flush" contaminated sediments downstream." How effectively will the proposed alternative address this transport mechanism? Was consideration given to sending some stormwater flow around the upper HBHA retention area and directly into the lower portion of the HBHA?

The RTC is not yet comfortable with this proposed plan. More study or explanation is needed to address the issues raised above.

For further discussion or if you require any additional information, please contact me at 617-568-5960.

Sincerely,

RTC Realty Trust

By: Christopher Gordon, Trustee
Massachusetts Port Authority

cc: K. Beasley, M. Victor, K. Choe, MPA; Mark Boyle, MBTA; Lionel Lucien, MHD

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Attn: Mr. Joseph LeMay

MASSACHUSETTS PORT AUTHORITY
CAPITAL PROGRAMS DEPARTMENT

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TO: Joseph F. LeMay	FROM: Antonina Villa
COMPANY: U.S. EPA	DATE: 08/31/05
FAX NUMBER: (617) 918-1291	SENDER'S FAX NUMBER: (617) 568-5998
PHONE NUMBER:	SENDER'S PHONE NUMBER (617) 568-5950
RE: RTC Realty Trust Comments	TOTAL NO. OF PAGES INCLUDING COVER: 2

☐ URGENT ☐ FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE

NOTES/COMMENTS:

ONE HARBORSIDE DRIVE, STE. 200S
EAST BOSTON, MA 02128

SDMS DocID 237510

SUDBURY RESEARCH CENTER, LLC

200 West Cummings Park • Woburn, MA 01801 • phone: 781-935-8000 • fax: 781-935-1990

BY REGULAR MAIL AND FACSIMILE: 617-918-1291

August 31, 2005

Joseph F. LeMay
U.S. Environmental Protection Agency
1 Congress Street, Suite 1100 (HBO)
Boston, MA 02114

Re: Notification of Potentially Interested Party of EPA's Forthcoming Proposed Cleanup Plan for the Industri-plex Superfund Site, Operable Unit-2, and including Wells G&H Superfund Site, Operable Unit 3, Aberjona River Study, Woburn, Massachusetts

Dear Mr. LeMay:

Sudbury Research Center, LLC ("SRC") is the owner of property at 34 Commerce Way, Woburn, Massachusetts. We are writing in response to the above notice, which we received on July 1, 2005. The notice states we have a "special interest" in these Superfund Sites. Our property has, however, never been part of either Superfund Site, nor has it been targeted as a source of contamination by the Environmental Protection Agency ("EPA") or the Massachusetts Department of Environmental Protection ("DEP"), so we are confused as to what our special interest may be.

We have the following concerns about this notice and about the EPA's proposed plan ("the Plan"):

1. We do not want our property to be incorporated into these Superfund Sites. This creates problems in dealing with tenants, lenders and others, and will meaningfully decrease the value of our property.

2. We are worried that this notice may be followed with a demand for some financial contribution by SRC to the cost of implementing the Plan. We are an innocent downgradient landowner and should not have to pay for problems that were created somewhere else.

3. The possibility of federal institutional controls on our property concerns us. The scope of these proposed controls has not been spelled out, and we believe that such a program under the federal government is more onerous than similar programs under the DEP. We request that EPA start with trying to have property owners implement voluntary controls, if necessary, and then work with the DEP, with which the real estate industry is much more familiar, in order to minimize the negative impact of controls on property owners.

We understand that the city of Woburn and others are seeking an extension of the public comment period and funding by EPA for peer review of the Plan. Since a delay in implementing the Plan will not jeopardize the public health or welfare and is being requested for entirely valid reasons, we encourage EPA to grant this extension and provide funding for this review before the proposed Plan is finalized. In addition, we request that EPA meet with representatives of the affected property owners to get our input, so that we can be sure all parties' interests are fully taken into account in this process.

Thank you.

Sincerely,

SUDBURY RESEARCH CENTER, LLC

Dennis Clarke

Dennis A. Clarke

M:\...\#LEMAY-SRC.DOC

Sudbury Research Center, Inc.
200 West Cummings Park
Woburn, MA 01801

H50

Joseph F. LeMay
U.S. Environmental Protection Agency
One Congress Street, Suite 1100 (HBO)
Boston, MA 02114

02114-2010

SUDBURY RESEARCH CENTER, LLC
200 West Cummings Park • Woburn, MA 01801 • phone: 781-935-8000 • fax: 781-935-1990

FACSIMILE COVER SHEET

TO:	Joseph F. LeMay	**FAX:**	617-918-1291
	US Environmental Protection	**PHONE:**	
FROM:	Dennis A. Clarke	**DATE:**	August 31, 2005
RE:	Industri-Plex Superfund Site		
NUMBER OF PAGES: 2 (Not including cover sheet)		If you have difficulty with this transmission, please call 781-932-7037	

MESSAGE

CONFIDENTIALITY NOTICE

MHP REALTY, LLC

200 West Cummings Park
Woburn, MA 01801
781-935-8000

BY REGULAR MAIL AND FACSIMILE: 617-918-1291

August 31, 2005

Industri-Plex
4.1
237511

Joseph F. LeMay
U.S. Environmental Protection Agency
1 Congress Street, Suite 1100 (HBO)
Boston, MA 02114

Re: Notification of Potentially Interested Party of EPA's Forthcoming Proposed Cleanup Plan ("the Plan") for the Industri-plex Superfund Site, Operable Unit-2, and including Wells G&H Superfund Site, Operable Unit 3, Aberjona River Study, Woburn, Massachusetts ("the Site")

Dear Mr. LeMay:

On July 1, 2005, this firm received the above-referenced notice, supposedly because we have a "special interest" in the Site. We own real estate at 10 Commerce Way, Woburn, Massachusetts. This property has never been part of the Site, although on occasion we have voluntarily provided access to the Environmental Protection Agency ("EPA") for testing.

We are concerned that somehow our property is now being pulled into the Site, an outcome with grave consequences for a commercial landowner. Indeed, had we known of this potential action, it is likely we would not have purchased this property or would have paid significantly less for it. The Plan will create a real stigma on our property, pose problems both with potential tenants, particularly large, sophisticated companies, and with potential lenders, and depress the value of our property. At the municipal level, this will decrease the City's tax revenues and likely harm city services.

We are also worried that this notice may be a precursor to some financial assessment for the Plan's costs, notwithstanding that we are an innocent downgradient landowner.

In addition, we are concerned about the possibility that federal institutional controls may be imposed on our property. We have already achieved a Response Action Outcome ("RAO") under the Massachusetts Contingency Plan ("MCP") on account of conditions that originated off-site and pre-dated our purchase of the property in 1995. As part of our RAO, we have already implemented an Activities and Use Limitation ("AUL"), based on the findings and opinions of a Massachusetts Licensed Site Professional. This AUL, which has been audited by the Massachusetts Department of Environmental Protection ("DEP"), prohibits residential and day care uses, and requires special procedures for excavations below a certain depth.

We believe that the oversight of DEP and the existing AUL are sufficient to protect the public health and welfare, without additional and duplicative federal controls. We understand that the institutional controls that were put in place at the Industri-plex Superfund Site were modeled after the MCP, making it likely that any new ones under the Plan will be, too. Why add an extra layer of federal controls, which may be more cumbersome to implement and modify, when the state program is already working and is much more palatable for the real estate industry?

The city of Woburn and others have requested an extension of the public comment period and funding for peer review of the Plan. Because of the many, many pages of technical materials and the significant impact the Plan would have, we urge EPA to grant this extension and provide funding for this review before the Plan is finalized. In addition, we also urge you to meet with representatives of the affected parties to ensure that all parties' interests are fully considered in this process.

Thank you for your attention to this matter.

Sincerely,

MHP REALTY, LLC

MHPascavage

Michael H. Pascavage, AIA

M:\LEGAL\BRAND\#LEMAY-MHP.DOC

MHP REALTY
200 West Cummings Park
Woburn, MA 01801

Hbo

Joseph F. LeMay
U.S. Environmental Protection Agency
One Congress Street, Suite 1100 (HBO)
Boston, MA 02114

02114-2010

MHP REALTY, LLC

200 West Cummings Park
Woburn, MA 01801
781-935-8000
fax: 781-932-7006

FACSIMILE COVER SHEET

TO:	Joseph F. LeMay	**FAX:**	617-918-1291
	US Environmental Protection	**PHONE:**	
FROM:	Michael H. Pascavage	**DATE:**	August 31, 2005
RE:	Industri-Plex Superfund Site		
NUMBER OF PAGES: 2 (Not including cover sheet)		If you have difficulty with this transmission, please call 781-932-7037	

MESSAGE

CONFIDENTIALITY NOTICE

5 WCP, LLC

200 West Cummings Park
Woburn, MA 01801
781-935-8000

BY REGULAR MAIL AND FACSIMILE: 617-918-1291

August 31, 2005

Industri-Plex
4.1
237512

Joseph F. LeMay
U.S. Environmental Protection Agency
1 Congress Street, Suite 1100 (HBO)
Boston, MA 02114

Re: Notification of Potentially Interested Party of EPA's Forthcoming Proposed Cleanup Plan for the Industri-plex Superfund Site, Operable Unit-2, and including Wells G & H Superfund Site, Operable Unit 3, Aberjona River Study, Woburn, MA

Dear Mr. LeMay:

5 WCP, LLC ("5 WCP"), as a "potentially interested party," has received the above-referenced notice regarding the issuance of the Proposed Cleanup Plan (the "Plan") and the opportunity for comment thereon. 5 WCP owns the property at 330 Washington Street, Woburn, Massachusetts, which is a non-source area property in the Wells G&H Superfund Site (the "Site").

We have been informed by the EPA that the notice was provided to 5 WCP for EPA's access purposes at the Site and that none of the institutional controls proposed in the Plan apply to the 5 WCP property. We do not believe that it is necessary for EPA to secure access over 5 WCP's property through the Plan, however, because 5 WCP's predecessor-in-interest, Woburn Services, Inc., was a party to the Consent Decree for the Site which should already provide for EPA's access and establish the terms and conditions thereof.

We are seeking confirmation from the EPA that the Plan does not propose institutional controls for 5 WCP's property and request that no further access provisions be imposed. We would also like to be assured that no financial assessment be made on 5 WCP, a non-source area property owner, as a result of the Plan.

Thank you for your attention to this matter. Please feel free to call me with any questions or comments.

Sincerely,

Sangwha Hong

Sangwha Hong
Associate Counsel

5 WCP, LLC
200 West Cummings Park
Woburn, MA 01801

HBO

Joseph LeMay
U. S. Environmental Protection Agency
One Congress Street, Suite 1100 (HBO)
Boston, MA 02114

02114-2010

5 WCP, LLC

200 West Cummings Park
Woburn, MA 01801

781-935-8000
Fax: 781-932-7006

FACSIMILE COVER SHEET

TO:	Joseph F. LeMay	**FAX:**	617-918-1291
	US Environmental Protection	**PHONE:**	
FROM:	Sangwha Hong	**DATE:**	August 31, 2005
RE:	Industri-Plex Superfund Site		
NUMBER OF PAGES: 1 (Not including cover sheet)		If you have difficulty with this transmission, please call 781-932-7037	

MESSAGE

PONTIAC PROPERTIES, LLP

200 West Cummings Park · Woburn, MA 01801 · 781-935-3000

BY REGULAR MAIL AND FACSIMILE: 617-918-1291

August 31, 2005

Joseph LeMay
U.S. Environmental Protection Agency
Region I
1 Congress Street, Suite 1100 (HBO)
Boston, MA 02114

Re: EPA's Proposed Cleanup Plan for Industri-plex Superfund Site, Wells G&H Superfund Site, Aberjona River Study, Woburn, Massachusetts ("EPA's Proposed Plan")

Dear Mr. LeMay:

This letter is in response to the Potentially Interested Party ("PIP") notice by EPA dated June 30, 2005 and received by Pontiac Properties, LLP ("Pontiac") regarding the above-referenced matter.

The Pontiac property at 12 Cabot Road, Woburn, MA 01801 is near to, but not part of, the Industri-plex or Wells G&H Superfund sites. Pontiac would qualify as a downgradient property owner to the extent any oil and/or other hazardous materials ("OHM") from those sites has reached Pontiac's property.

Because EPA's Proposed Plan recommends institutional controls on PIP properties that are not part of the sites, Pontiac believes a more comprehensive site assessment should be conducted to determine the scope, nature and extent of OHM emanating from the sites. The public will also be better served once a more comprehensive site assessment has been done.

The implementation of institutional controls at non-site properties has the potential to seriously damage Pontiac's -- and other PIPs' -- property interest by bringing it under the CERCLA and/or M.G.L. Chapter 21E umbrella. While the use of institutional controls might appear to be prudent as a prophylactic measure, such remedy will only paint a "Scarlet Letter" on Pontiac's property and may jeopardize any future use and sale of the property, or make it more difficult to obtain commercial financing and liability insurance.

Accordingly, Pontiac urges EPA to extend the public comment period pending a more comprehensive site assessment and further investigation of the scope of OHM that might be emanating from the existing site boundaries, and conduct further consultation with other PIPs to fully assess the impact of EPA's Proposed Plan on their non-site properties.

Very truly yours,

Pontiac Properties, LLP

Paul Escobar

Paul Escobar, Counsel

Pontiac Properties, LLP
200 West Cummings Park
Woburn, MA 01801

HBO

Joseph LeMay
U. S. Environmental Protection Agency
Region 1
1 Congress Street, Suite 1100 (HBO)
Boston, MA 02114

02114-2010

PONTIAC PROPERTIES, LLP

200 West Cummings Park · Woburn, MA 01801 · 781-935-8000

FACSIMILE COVER SHEET

TO:	Joseph F. LeMay	**FAX:**	617-918-1291
	US Environmental Protection	**PHONE:**	
FROM:	Paul E. Escobar	**DATE:**	August 31, 2005
RE:	Industri-Plex Superfund Site		
	NUMBER OF PAGES: 1 (Not including cover sheet)		If you have difficulty with this transmission, please call 781-932-7037

MESSAGE

CONFIDENTIALITY NOTICE

Cummings Properties

www.cummings.com

BY REGULAR MAIL AND FACSIMILE: 617-918-1291

Industri-plex
4.1
237514

SDMS DocID 237514

August 31, 2005

Joseph F. LeMay
U.S. Environmental Protection Agency
1 Congress Street, Suite 1100 (HBO)
Boston, MA 02114

Re: Proposed Cleanup Plan for the Industri-plex Operable Unit 2 Superfund Site (including Wells G & H Operable Unit 3), Woburn, MA ("the Plan")

Dear Mr. LeMay:

Just two months ago, Cummings Properties, LLC received notice as a "potentially interested party" of the issuance of the Plan and the opportunity to comment on it. Since, to date, this firm has had no involvement with the Industri-plex Superfund Site ("the Site"), with no properties owned or under management within the boundaries of the Site, we were surprised to receive this notice.

Given the size and complexity of technical documents that represent, document, and support the Plan (over 12,000 pages long), it is neither realistic, reasonable, and/or feasible for U.S. Environmental Protection Agency ("EPA") to expect Cummings to identify and/or retain the required experts to undertake a meaningful analysis of the Plan in 60 days. Furthermore, Cummings is concerned that the EPA has not appropriately considered all of the facts and circumstances in drafting the Plan, including, but not limited to: the impact of the Plan on localized and areawide flooding of the Aberjona River due to lost stormwater detention capacity that will probably result from the Plan; the implications of requiring innocent, downgradient property owners to implement federal institutional controls; and other land use and land valuation issues that must be evaluated in order to provide meaningful comments on the Plan.

Based on everything that we have learned in this very short period of time about the Site and the Plan, we are very concerned that the U.S. Environmental Protection Agency ("EPA") is rushing to judgment without allowing full and meaningful public comment and participation in the formulation of the Plan. Accordingly, Cummings respectfully urges EPA to extend the comment period so that Cummings and other affected landowners may have sufficient time to review and provide written comments on the Plan. We also request that EPA provide funding for peer review as requested by the city of Woburn and other interested parties, and meet with potentially affected property owners and other stakeholders to discuss, in a meaningful way, the Plan, its impact and potential alternatives to the Plan.

Among other things, the Plan fails to recognize its economic impact, including the imposition of federal institutional controls, on properties subject to the Plan which have never been part of the Site but appear will become *de facto* part of an "expanded" Site. Our own experience with the Wells G&H Superfund Site, where our affiliates own properties, has shown us how substantially such action stigmatizes properties and reduces property values. This hurts both property owners and the city of Woburn, whose tax base would be reduced. This is particularly worrisome in the current economic climate, in which the commercial real estate industry is still reeling from the downturn of the past few years.

Specifically, we are particularly troubled by the implications of requiring innocent, downgradient property owners to implement federal institutional controls. The threat of such controls is also problematic because their terms have not been disclosed. In our experience, voluntary controls such as Activities and Use Limitations ("AULs") under the Massachusetts Contingency Plan are very workable and are familiar to lenders, tenants and the like. A voluntary approach could lessen the stigma that might otherwise arise, and thereby lessen the impact on property values and tax revenue. We urge EPA to reconsider the need for institutional controls and work with property owners to establish voluntary protocols such as AULs or, in the alternative, place these matters under the oversight of the Massachusetts Department of Environmental Protection.

We are also concerned that properties that have historically been outside of the Site may be exposed to liability to the government or existing responsible parties. EPA should commit to not seek any financial contribution from these properties to the Plan, and provide whatever protection it can legally provide against claims for contribution by the owners of property within the existing Site.

In conclusion, Cummings reiterates its request that EPA extend the public comment period, provide funding for peer review in order to allow for a meaningful dialogue with the city of Woburn and other interested parties, and begin a dialogue with the key stakeholders, including the property owners who will be affected by the Plan. Fairness requires that EPA, which has studied the Site for years, postpone the issuance of a Record of Decision ("ROD") until it has provided the public the opportunity to meaningfully study the Plan, and that EPA meet with all interested parties to identify the appropriate clean up mechanisms before considering whether to expand the boundaries of the Site and entering a ROD. Indeed, Cummings urges EPA **not** to proceed with entering a ROD for the Plan unless and/or until an adequate time extension has been granted and such a dialogue is underway. Otherwise it will seem as though EPA has already made the clean-up decision in advance, without taking into consideration any comments submitted by the public.

Thank you for your attention to this matter. Please feel free to call me with any questions or comments.

Sincerely,

Susan F. Brand

Susan F. Brand
General Counsel

M:\LEGAL\BRAND\#LEMAY-CPL.DOC

Cummings Properties
200 West Cummings Park
Woburn, Massachusetts 01801

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2005

USA

HBO

Joseph F. LeMay
U.S. Environmental Protection Agency
One Congress Street, Suite 1100 (HBO)
Boston, MA 02114

02114-2010

Cummings Properties

200 West Cummings Park
Woburn, MA 01801
phone: 781-935-8000
fax: 781-932-7006

FACSIMILE COVER SHEET

DATE:	August 31, 2005	**NO. OF PAGES:**	2 (Including cover sheet)
TO:	Joseph F. LeMay	**FAX:**	617-9181291
	US Environmental Protection Agency	**PHONE:**	
FROM:	Susan F. Brand, General Counsel	**CITY:**	
RE:	Industri-Plex Superfund Site		
If you have difficulty with this transmission, please call: 781-932-7037			

MESSAGE

CONFIDENTIALITY NOTICE

John C. Curran
Mayor

CITY OF WOBURN
MASSACHUSETTS

SDMS DocID 237515

City Hall
10 Common Street
Woburn, MA 01801

Tel (781) 932-4501
Fax (781) 932-4506

Industri-Plex
4.1
237515

August 31, 2005

Mr. Joseph F. LeMay
Remedial Project Manager
US EPA – New England
One Congress Street, Suite 1100 (mail code: HBO)
Boston, MA 02114-2023

Dear Mr. LeMay:

The City of Woburn does not question the ultimate goal of the remedy the Environmental Protection Agency has proposed. The concept and premise of the design seem sound. However, one area of concern is the amount of dredging proposed within the Halls Brook Holding Area. There appear to be two schools of thought. One being that the best remedy involves the complete removal of all contaminated sediments and the other being that the very act of removal may cause a greater risk for release of sediments downstream.

In any case the city is interested in the best solution for the problem. The city has been exploring the possibility of an independent review to ensure the best possible solution is implemented. Unfortunately, funding has been a major obstacle to this review process.

I will continue to explore ways to obtain funding for this purpose. In the mean time it is essential for the EPA to continue to consider input from all interested parties; the city, environmental groups and the PRPs before a record of decision is issued. I would be happy to offer the city's services to help facilitate this process.

If you have any questions please do not hesitate to call me at (781) 932-4501.

Sincerely,

John C. Curran
Mayor, City of Woburn

CITY OF WOBURN
MASSACHUSETTS

John C. Curran
Mayor

City Hall
10 Common Street
Woburn, MA 01801

Tel (781) 932-4501
Fax (781) 932-4506
jcurran@ci.woburn.ma.us

TELEFAX MESSAGE

Date: September 1, 2005

To: Joe Lemay

Telefax No. 617-918-1291

From: Mayor Curran

Re:

Message:

Following are 1 page (s), not including this cover. If received in poor condition or if incomplete, kindly notify the telefax sender (781)-932-4501.

"Curran, John" <JCurran@cityofwoburn .com
>

08/31/2005 09:47 PM

To Joe Lemay/R1/USEPA/US@EPA, Joe Lemay/R1/USEPA/US@EPA

cc "Fralick, John" <JFralick@cityofwoburn.com>

bcc

Subject Response - City of Woburn

Joe,

I have attached a response for the comment period.

Talk to you soon,

John Curran lettercommentepa.doc

CITY OF WOBURN
MASSACHUSETTS

Mayor John C. Curran
City Hall • 10 Common Street
Woburn, MA 01801

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Mr. Joseph LeMay
Remedial Project Manager
US EPA - NewEngland
One Congress St., Suite 1100
Boston, MA 02114-2023

HBO

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Environmental Research Institute
University of Connecticut
U-210; Longley Building
Storrs, Ct 06269-3210
Phone; 860-486-4015
Fax: 860-486-5488

ERI
ENVIRONMENTAL RESEARCH INSTITUTE

Fax

To:	Joe Lemay	**From:**	Chris Perkins
Fax:	617-918-1291	**Pages:**	[Click here and type number]
Phone:		**Date:**	8/31/2005
Re:	Industri-plex	**CC:**	

☐ **Urgent** ☐ **For Review** ☐ **Please Comment** ☐ **Please Reply** ☐ **Please Recycle**

• **Comments:**

Joe;

Please see the attached comments on the Indutriplex remedial plan. We were asked by the City council to review the proposed plan under the TOSC program. I will be emailing this document to you as well.

Chris Perkins

Comments on the Proposed Remedial Plan for the

Wells G & H Superfund Site

Industri-plex Superfund Site

Operable Units 2&3

Woburn, Massachusetts

Christopher Perkins and Kevin Hood
University of Connecticut
Technical Outreach Service to Communities (TOSC)
USEPA Center for Hazardous Substances in Urban Environment

The TOSC program was requested to conduct a third party review of the "Proposed Cleanup Proposal for the Industri-plex Operable Unit 2 and Wells G&H Sites- June 2005" by the Woburn City Council. We have critically reviewed the document and the associated draft final feasibility study and are comments are detailed below.

In general, we found this document and the supporting feasibility study very geneneralized and short on specifics. Between this fact and the short time to review all of the applicable documentation, this made it very difficult to critically review the proposed cleanup proposal in light of our overarching criteria of 1) will it work; and 2) is it safe. While we believe that the remedial alternatives proposed by the USEPA will theoretically meet these two criteria, the lack of specifics and background information for some alternatives give us some cause for concern. We will detail these concerns and questions below.

1) Sufficiency of the five year review period. It is our belief that the five year review period is inadequate to monitor/ ensure the effectiveness of some of the proposed remedies and also to keep a properly informed public. Since there is a heavy reliance on institutional controls and some *in-situ* remediation activities rather than removal actions, we believe that it would be in the best interest to have annual reviews of the monitoring data generated with an accompanying public meeting. This will serve two purposes: 1) it will allow for a more timely review of the data to determine the efficacy of the proposed activities, especially the chemical oxidation, and if mid-course adjustments need to be made, then they can be accomplished sooner, rather than later; 2) It will keep the public "in the loop" and active in the process. With the heavy reliance on institutional controls to minimize exposure, yearly meetings will help keep the focus of the organizations that will be responsible for implementing and enforcing/ monitoring these controls.

2) Effectiveness of the proposed enhanced bioremediation for groundwater (Alternative GW-4): We were unable to determine if a site specific treatability

study was performed using the proposed oxygenates (which were not detailed) to determine if this treatment method would be applicable for this site. Since there are many factors that influence in-situ oxidation, a careful evaluation of the site-specific parameters and the extent of contamination is crucial to the proper application and success of this remedial technology. There is a need to understand the interaction between native soil and oxidants, determine soil oxidant demand (SOD), and to determine efficacy of oxidants on target compounds. Conducting this study and analyzing and subsequently reporting the data could go a long way to determine if this proposed remediation method will be effective.

3) The adequacy and ambiguity associated with proposed institutional controls (ICs): One of our primary concerns with the proposed activities on this site is the heavy reliance upon un-named institutional controls to ensure protection of human health. Our concern lies with the lack of specifics on these proposed controls, especially which organizations would be responsible for implementation, monitoring and enforcement, and their long term viability. In many areas, ICs will most likely be the onus of the City of Woburn and they will need to implement and monitor their effectiveness. Will the annual O&M costs associated with institutional controls, as listed in Table 4-29, be provided to the city or other entity to whose responsibility this will be delegated to, or are these monies to be used for monitoring and analysis? The use of an institutional control to meet a standard should include a mechanism to ensure the maintenance of the institutional control. How often will the USEPA review the ICs and their effectiveness? The September 2004 USEPA IC strategy states a five year review, but this may be inadequate (see comment 1). By not detailing or proposing which controls would be appropriate, we are unable to determine if these will be effective in the long term or in the best interests of the public and the City of Woburn.

There is also tremendous concern from property owners on how these un-named institutional controls will affect property rights and use and the properties associated value. Again, the lack of detail leads to great concern on our part and whether these will be in the best interest of the public.

4) Potential mobilization of contaminants from the excavation of the HBHA Pond sediments. We have some concern that there may not be adequate protection for downstream receptors during the removal of the contaminated sediments from the HBHA pond. This concern primarily relates to the use of a hydraulic excavator, rather than a hydraulic dredge, to remove those sediments. Two possible site preparation methods (and the nebulous "other") are listed to help mitigate for sediment transport.

5) The use of the coffer dams to contain sediment: There is no discussion of the effect that the two coffer dams could have upon storm water retention and flow in the HBHA Pond area. This area appears to be a primary conduit of storm water

from the Industriplex area and the North and South Ponds, so will this be alternative be effective in mitigating the mobilization of contaminants during storm and highwater events?

In summary, we believe that the methods listed in the proposed remediation plan will be adequate to ensure human health, the "devil is in the details". We wish that the proposed plan was more detailed, which would allow for a more thorough analysis of the document.

Sincerely;

Christopher Perkins
And
Kevin Hood Kevin Hood

Technical Outreach Services to Communities
ERI; Longley Bldg; U-5210
University of Connecticut
Storrs, CT 06269
Ph: 860-486-4015

Resources for Responsible Site Management, Inc. (RRSM)
Trustee for the Industri-plex Superfund Site Custodial Trust

RRSM is a subsidiary of GETG, Inc.
GETG, Inc.
Greenfield Environmental Trust Group, Inc.

44 Shattuck Road, Watertown, MA 02472
P.O. Box 487, Chestnut Hill, MA 02467
Telephone: (617) 448-9762 Facsimile: (866) 871-7668

By Electronic & U.S. Mail

August 31, 2005

Joseph LeMay
Remedial Project Manager
Massachusetts Superfund Section
Office of Site Remediation & Restoration
U.S. EPA – New England (Region I)
One Congress Street
Suite 1100 (mail code: HBO)
Boston, MA 02114-2023

Robert G. Cianciarulo
Chief
Massachusetts Superfund Section
Office of Site Remediation & Restoration
U.S. EPA – New England (Region I)
One Congress Street
Suite 1100
Boston, MA 02114-2023

RE: Public Comments on the Proposed Cleanup Plan for the Industri-plex Superfund Site, Operable Unit-2, and including Wells G&H Superfund Site, Operable Unit-3, Aberjona River Study, Woburn, Massachusetts (the "Proposed Cleanup Plan")

Dear Joe:

The purpose of this letter is to submit the written comments of Resources for Responsible Site Management, Inc. (RRSM), as Trustee of the Industri-plex Superfund Site Interim Custodial Trust (the "Custodial Trust"), to the U.S. Environmental Protection Agency (EPA) in connection with the public comment period established by the EPA for the above-referenced Proposed Clean-up Plan. The Custodial Trust is also hereby responding in writing to the EPA's letters of June 30, 2005 and July 20, 2005.

Since assuming its responsibilities as Trustee in 1989, RRSM has been honored to serve the fiduciary and other needs of the three distinct beneficiaries of the Custodial Trust: the City of Woburn; the Industri-plex Site Remedial Trust (ISRT); and, of course, your agency, EPA, in consultation with the Massachusetts Department of Environmental Protection (DEP). In continued fulfillment of our obligations to our three beneficiaries, the Custodial Trust has considered the fiduciary, environmental, regulatory, economic and other impacts that the Proposed Clean-up Plan may have on its three beneficiaries.

As a matter of public record, the Custodial Trust also shares the broader multi-stakeholder goal of achieving the earliest possible clean-up for the benefit of the public at large. Please note that to date the Custodial Trust has not retained the required technical expertise to perform an independent review of the Proposed Clean-up Plan and, therefore, our comments and recommendations relate to the EPA's overall methodology, strategy and priorities as they relate to the Proposed Clean-up Plan.

Accordingly, having considered the costs and benefits of the Proposed Clean-up Plan to the City of Woburn (inclusive of the community of residents, businesses and other stakeholders that are represented by and/or affiliated with the City), the ISRT, and the EPA/DEP, the Custodial Trust submits the following comments on the Proposed Clean-up Plan.

EPA Should Extend the Public Comment Period (Beyond August 31, 2005):

Community groups, residents, City officials, private landowners and potentially responsible parties have made numerous appeals to EPA for an extension to the 60-day public comment period. EPA may routinely receive such requests for additional time; however, it is difficult to imagine another superfund site where so many diverse stakeholders seem to unanimously agree on a single critical issue. EPA has the absolute discretion (under its own rules, directives and guidelines) to grant any of the extensions that have been requested.

The Custodial Trust believes that granting such an extension is in the best interests of its three beneficiaries, including EPA. An extension would promote broader stakeholder understanding of and buy-in to the Proposed Clean-up Plan and thereby foster the collaboration that will ultimately result in the most timely, efficient implementation of the Proposed Clean-up Plan. Granting such an extension would therefore be more, rather than less protective of public health and the environment and more consistent with EPA's mission. It would convey the sincerity of EPA's commitment to community collaboration and, more important, it would help dispel suspicions that EPA has already decided on its preferred clean-up plan in advance.

The Custodial Trust believes that, if EPA chooses to ignore these many requests for "reasonable opportunity to provide written comments," the foundation of openness and trust—slowly and painstakingly re-built since Woburn discovered it had been betrayed by government and industry beginning in the 1970's—will be damaged. At a minimum, it will lead to unnecessary frustration, resentment, and confusion. Under the worst case scenario, it will tarnish the process going forward and potentially lead to litigation that could prevent any real progress on the Proposed Clean-up Plan. Under that scenario, all beneficiaries of the Custodial Trust, including EPA, would loose.

EPA Should Open a Dialogue with the Stakeholders

The Custodial Trust respectfully urges the EPA to consider the merits of opening a dialogue with the City, the ISRT and the other impacted stakeholders in an effort to promote a more cooperative approach to implementing the final stage of clean-up for Industri-plex (and Wells G&H). Such an approach would entail building upon—not abandoning—the unprecedented cooperation amongst the public and private sectors as well as among local, state and federal governments that made Industri-plex the "superfund success story" it represents today for all stakeholders, including EPA. A collaborative, more inclusive process would minimize stigmatization of the City and likely deliver a much more efficient and immediate clean-up that is protective of human health and the environment.

Public and private resources that can and should be spent on clean-up and economic development would not be unnecessarily dissipated on matters of enforcement, liability, blame and litigation. **Even if there were no more than an even chance of success, we believe that EPA should feel itself hard-pressed to simply ignore the multiple requests for dialogue and outreach from this unique, experienced group of stakeholders, especially when such a dialogue could potentially avoid an otherwise contentious clean-up process, creating more superfund property, re-kindling Woburn's superfund stigma and delaying clean-up of the river.**

Specifically, the Custodial Trust proposes a minimum 60-day moratorium on the CERCLA enforcement process. During this time the beneficiaries of the Custodial Trust and other major stakeholders could meet with EPA to begin a dialogue and establish a more collaborative framework for implementing the Aberjona River clean-up. Sixty days is insignificant in contrast to the decades during which the Aberjona River has been studied. Additionally, according to EPA's own thorough and extensive findings, there is no imminent risk to human health that warrants proceeding without such a dialogue.

The Custodial Trust recognizes that EPA is fully within its authority to pursue the superfund enforcement path. The Custodial Trust itself has benefited from the valuable incentives and tools afforded the EPA under superfund that are needed to accomplish the agency's important environmental missions. If, therefore, notwithstanding the good faith efforts of the stakeholders, including the Custodial Trust, the parties are unable to establish the basis for a meaningful dialogue and a plan for implementation of a cooperative clean-up of the Aberjona River, EPA is always free to pursue the traditional enforcement route.

The Custodial Trust optimistically and respectfully urges EPA to agree to the requests and recommendations outlined herein. As the Trustee that has served EPA's fiduciary and other needs with respect to Industri-plex property for sixteen years, the Custodial Trust sincerely hopes that EPA will take the time to carefully consider the merits of these recommendations and the accompanying benefits that would inure to all stakeholders, including EPA. Please do not hesitate to call me with any questions (617-448-9762).

Sincerely,

Cynthia N. Brooks
President, RRSM
Trustee for the Custodial Trust
Industri-plex Superfund Site

cc: John Beling – US EPA – I – Office of Regional Counsel
Angela Bonarrigo – US EPA – I – Community Relations
Andy Cohen – MA. DEP – Office of General Counsel
The Honorable John Curran – Mayor, City of Woburn
Jack Marlowe – Woburn Redevelopment Authority
Anna Mayor – MA, DEP – Bureau of Waste Site Clean-up
Paul Medeiros – President, Woburn City Council
Luke Mette – Stauffer Management Company
Jerry Rinaldi – Solutia Inc.
Peter Virden Jr – Monsanto Company
Marc Weinreich – RRSM, Custodial Trust
Woburn City Council:
President Paul Medeiros, Alderman, Ward 5
Alderman Charles E. Doherty, Ward 1
Alderman James E. McSweeney, Ward 2
Alderman Scott D. Galvin, Alderman Ward 3
Alderman William N. Booker, Ward 4
Alderman John A. Ciriello, Ward 6
Alderman Thomas L. McLaughlin, Ward 7
Alderman-at-Large Paul J. Denaro
Alderman-at-Large Joanna Gonsalves

Tom Alperin – National Development, President
Bryan Clancy – National Development, Vice President
Dennis Clarke – Cummings Properties, President & CEO
Susan Brand – Cummings Properties, General Counsel
Christopher Gordon – Massachusetts Port Authority, RTC
Linda Raymond – Aberjona Study Coalition, Inc.

Cynthia Brooks
<cb@g-etg.com>
08/31/2005 04:27 PM

To Joe Lemay/R1/USEPA/US@EPA, Bob Cianciarulo/R1/USEPA/US@EPA
cc Angela Bonarrigo/R1/USEPA/US@EPA, John Beling/R1/USEPA/US@EPA
bcc
Subject Custodial Trust Comments on Proposed Plan

Please find attached the Custodial Trust's comments on the EPA's Proposed Plan for the Industri-plex Superfund Site Operable Unit 2 (including Wells G&H Operable Unit 3), Woburn, MA.

Cynthia Brooks
President, GETG, Inc.
Greenfield Environmental Trust Group, Inc. &
Resources for Responsible Site Management, Inc. (RRSM)
(617) 448-9762

Custodial Trust Comments to EPA 8-25-05.pdf

SDMS DocID 237556

"Hackney III, H. Hamilton"
<HHackney@choate.com>
08/31/2005 01:36 PM

To Joe Lemay/R1/USEPA/US@EPA
cc
bcc
Subject Industri-plex Superfund Site Operable Unit 2/Wells G&H Operable Unit 3

Dear Mr. LeMay - on behalf of the Town of Winchester, we are submitting the attached comments regarding the Industri-plex Superfund Site Operable Unit 2/Wells G&H Operable Unit 3 Draft Multiple Source Groundwater Response Plan Remedial Investigation Report. Thank you for your attention to this matter.

Sincerely,

H. Hamilton Hackney III
Partner
Choate, Hall & Stewart LLP
Two International Place
Boston, MA 02110

t 617-248-4097
f 617-248-4000

If you cannot reach me directly, please contact my assistant Suzan Shaw at 617-248-4809 (sls@choate.com).

CHOATE

3977693_1(Exchange).DOC

Via Electronic Mail (lemay.joe@epa.gov)

Mr. Joseph LeMay
Remedial Project Manager
USEPA – New England
One Congress Street, Suite 1100
Boston, MA 02114-2023

Re: Industri-plex Superfund Site Operable Unit 2
Wells G&H Operable Unit 3
Draft Multiple Source Groundwater Response Plan Remedial Investigation Report

Dear Mr. LeMay:

In response to the above-referenced document, the Town of Winchester would like to offer the following comments. The Town appreciates your agency's continuing efforts to address this large and complex cleanup project, which affects a number of communities along the Aberjona River.

As you know, the Town has been engaged for more than a decade in extensive planning, design and construction projects to mitigate wide-spread flooding impacts that the Town and its residents suffer along the Aberjona River. Presently, the Town has identified multiple projects along the Aberjona that would provide significant flood relief if implemented. The Town has been working closely with the Army Corps of Engineers to plan and implement this work. We wish to ensure that the remedial actions that USEPA is proposing in and along the Aberjona do not interfere with or compromise the effectiveness of the Town's flood control work.

We will forward to you under separate cover the Environmental Notification Form that the Town submitted to the Massachusetts MEPA Office and other documents providing further details on the Town's flood control projects. Once you have had an opportunity to review that information, the Town would like to meet with USEPA and the Army Corps to discuss potential impacts that the proposed remedial work may have on the Town's projects. We would initially suggest scheduling a meeting on September 30, and will call you shortly to confirm a convenient date.

We look forward to working with the USEPA on this important cleanup project.

Respectfully Yours,

Karl Fryzel, Chair
Winchester Board of Selectmen

3977693v1

MYSTIC RIVER WATERSHED ASSOCIATION
20 ACADEMY STREET, SUITE 203
ARLINGTON, MA 02476

August 31, 2005

Mr. Joseph F. LeMay, P.E.
Remedial Project Manager
Suite 1100 (HBO)
1 Congress Street
Boston MA 02114-2023

RE: *Multiple Source Groundwater Response Plan (MSGRP) Remedial Investigation* and the *MSGRP Feasibility Study and Proposed Plan* – Industri-Plex Site.

Dear Mr. LeMay:

The Mystic River Watershed Association (MyRWA) is a community-based nonprofit organization established in 1970 to promote restoration and protection of the water-based natural resources of the 21 communities in the Mystic River watershed. The watershed includes the Aberjona and Mystic Lake subwatersheds, which are the subject of the studies in question.

MyRWA is a member of the Aberjona Study Coalition, Inc. (ASC), which is submitting comments on these studies on behalf of all of its members. MyRWA fully concurs with those comments, which we will not repeat here. This letter raises additional concerns about the schedule and the process for reaching a final decision about remediation of the valuable resources contaminated by the Industri-Plex and Wells G&H sites. **MyRWA requests that EPA extend the comment period for the Feasibility Study in several phases, and that EPA provide additional information to support public discussion at each phase.** The following explains our reasons for these requests.

The process of evaluating risks from Superfund sites, and selecting a plan to address those risks, includes five important steps:

1. **Risk Analysis** – determining how contamination from these two Superfund sites has affected off-site areas and what risks the contamination presents to human health and the environment.

2. **Selecting Remedial Action Objectives** – given these risks, determining the appropriate goals of a remediation plan that would reduce risks to an acceptable level. This is an essential policy decision – determining what risks should and should not be addressed, the extent to which contamination should be reduced, and where to simply prevent exposure rather than remediating the contamination.

3. **Identifying Remedial Action Alternatives** – given the goals of the remediation plan, identifying alternative ways to achieve the goals. Alternatives include both remediation actions (removing or immobilizing the contamination) and "institutional controls"

(leaving the contamination in place and adopting procedures to prevent exposure to the contamination). It is important that an appropriate list of remedial action alternatives is selected for analysis, and that potentially effective options are not excluded from the list. In practice, viable alternatives are often excluded from consideration prematurely, based on a judgment that they would be too expensive or not effective. These decisions about which alternative to analyze should be subject to public review -- the public is entitled to the opportunity to consider and evaluate all viable alternatives, not just those highlighted by EPA and its consultants.

4. **Analyzing Each Selected Alternative** – assessing the effectiveness (both short- and long-term), the implementability, and the cost of each alternative. The methods used to analyze alternatives can bias the ultimate selection of a plan, if they do not fully capture the relevant characteristics of each option. For example, considering only the direct expenditures required to implement an alternative, and not the lost economic or property values associated with alternatives that limit future uses of a site, will bias the selection among alternatives. Similarly, alternatives can vary dramatically in the certainty of their long-term performance. An analysis that does not adequately assess uncertainty about the performance of different alternatives, or the necessity of long-term monitoring to ensure effectiveness, will result in a biased choice among the options.

5. **Choosing a Remediation Plan** – applying various policy criteria to choose among the alternatives to construct the overall plan. By necessity, choosing a final plan requires balancing different criteria – e.g., deciding when the cost for further risk reduction is "too high" or "not worth it." These are judgment calls that require serious public discussion.

At every stage of this process, there are both technical and policy issues to be addressed. The quality of the evaluation at each stage is only as good as the input provided by the previous stage. We recognize that it would be impractical to analyze every possible topic that might theoretically affect each stage. Choices must therefore be made at each stage about what to include in the evaluation. Choosing what is analyzed and how it is analyzed is just as important as ensuring that the analysis is technically correct. Moreover, the final choice of a remediation plan involves value judgments and policy decisions, for which there is no single "right" technical answer. The decisions require discussion and debate, based on a clear presentation of the pros and cons (including uncertainties) of different choices.

Of the five major steps in the process of developing a plan for Superfund sites, we have not yet even completed the first step, since there are still outstanding concerns about the risk analyses.[1] **The four steps required to determine how risks will be addressed present equally complex technical and policy issues as those presented by the risk analyses, and the public has had no previous opportunity to provide input on these steps.**

[1] Analyzing the risks associated with these sites has involved very complex technical analyses of different media, pollutants, and exposure pathways for different locations, and for both human health and ecological risks. The public has had the opportunity to comment on the design of the studies. The comments submitted by ASC express concerns about the adequacy and completeness of some components of the risk analyses, and MyRWA urges EPA to address those comments in full. We note that this is the first opportunity the public has had to comment on the September 2004 revisions to the risk analysis.

Clearly, the 60-day comment period allowed for the Feasibility Study is grossly inadequate for public review of these important steps. EPA has bundled all the remaining steps into a single report and asked the public to provide comments on the whole package, including the proposed remediation plan, within a very short period of time. It would have been more appropriate to invite public comment on the component steps as they proceeded, to ensure that the scope of the analysis at each stage provided the appropriate foundation for the next step. Since this was not done, MyRWA makes two requests at this time, to ensure that the public has a reasonable opportunity to provide input:

- **First, we request that the comment period for the Feasibility Study be extended and divided into phases.**

- **Second, we request that EPA and its consultants provide information in a format that will facilitate public understanding and effective input at each phase.**

An attachment to this letter proposes specific phases for this process and a requested information summary for each phase.

Everyone involved in this process, including MyRWA, is anxious to get beyond analysis and on to implementation of a remediation effort. It would be extremely shortsighted, however, to limit the public debate artificially at this critical stage in the process. Major choices will be irrevocably made once the Proposed Plan is approved. We urge EPA to ensure that the remediation objectives and alternatives are appropriately defined and analyzed, and that the results are communicated in a manner that allows the public to play a meaningful role in the selection of a final plan.

Thank you for considering MyRWA's comments on this important matter.

Sincerely,

Nancy Hammett

Nancy H. Hammett
Executive Director

cc Linda Raymond, Aberjona Study Coalition
Congressman Edward J. Markey
Anna Mayor, DEP Superfund Project Manager
Mayor John C. Curran
Paul Medeiros, President Woburn City Council

Proposed Schedule and Structure for Public Review of the Feasibility Analysis			
Phase	**Timing**	**Comment Period***	**Information Summaries Requested****
(1) Selecting Remedial Action Objective (RAOs)	Beginning now	1 month	For each study area, provide a matrix of pollutants, media, likely sources of contamination, exposure routes, and estimated human health and ecological risks. For each location/pollutant/media/source/exposure route combination, describe the proposed RAO and explain the basis for choosing the RAO. If no relevant RAO is recommended, provide a justification for taking no action.
(2)(a) Selecting Remedial Actions for analysis (2)(b) Describing methodologies for analyzing and comparing alternatives (including descriptions of the selection criteria that will be used based on the analyses.)	Beginning after EPA's Response to Comments on (1) and completion of additional analyses required by those comments.	2 months	For each Remedial Action Objective: • Identify the full range of technically-feasible alternatives; • Indicate which are proposed for analysis; • Provide a justification for excluding any that are not proposed for analysis. For each criterion to be used in Stage (3) to evaluate and compare alternatives, describe the analysis methodology and specific criteria to be used.
(3) Analysis of alternative remedies	Beginning after EPA's Response to Comments on (2) and completion of additional analyses required by those comments.	2 months	Summary of the results for each analyzed alternative (quantitative, where possible): • costs (all components, including lost future economic values and future monitoring and maintenance costs) • effectiveness (including all relevant measures of short- and long-term effectiveness and an explicit discussion of uncertainties and methods for dealing with them). • remaining risk levels for all relevant locations/pollutants/ media/ exposure routes.
(4) Selection of proposed Remedial Action Plan	Beginning after EPA's Response to Comments on (3) and completion of additional analyses required by those comments.	2 months	Comparison of alternatives for each Remedial Action Objective, and detailed explanation of the reasons for selection of the proposed alternative. Summary of precluded land uses for each case in which "institutional controls" are the proposed alternative, and the combined effect of all institutional controls on the future uses and values of specific locations.
* In each phase, we request a public meeting at which EPA will provide and explain the relevant information (including the summaries listed in the last column), and then a comment period of the suggested length *after* the information is provided at the public meeting.			
** The goal of the requested summaries is to provide a comprehensive overview of the analysis and proposed decisions. In some cases, the information is available in the documents that have already been provided, but is difficult for the public to extract. In other cases, the requested information may not be available in the reports already provided to the public.			

Hammett
Mystic River Watershed Assoc.
20 Academy Street #203
Arlington MA 02476

2005

Mr. Joseph F. LeMay, P.E.
Remedial Project Manager
Suite 1100 (HBO)
1 Congress Street
Boston MA 02114-2023

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02114+2010

Nancy Hammett
<nhammett@comcast.net>
08/31/2005 11:35 PM

To Joe Lemay/R1/USEPA/US@EPA
cc fitwalker1@aol.com, nancy@mysticriver.org
bcc
Subject MyRWA comments on Industriplex Feasibility Study

Please find attached the Mystic River Watershed Association's comments on the draft MSGRP Feasibility Study and Proposed Plan. A signed hard copy of these comments will follow by mail. You can contact me at nancy@mysticriver.org or 781-316-3438 if you have any questions about these comments.

Thank you.

Nancy Hammett Nancy Hammett.vcf MyRWA Feasibility Study Comment Letter 8-31-2005.doc

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UNLESS DESIGNATED OTHERWISE, OUR ATTORNEYS ARE ADMITTED ONLY IN MASSACHUSETTS

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♦ ONLY ADMITTED IN MARYLAND

August 31, 2005

By Hand Delivery
Joseph F. LeMay, P.E.
Remedial Project Manager
Office of Site Remediation and Restoration
United States Environmental Protection Agency
Region 1
1 Congress Street, Suite 1100
Boston, MA 02114-2023

RE: Comments on Proposed Plan for Industri-Plex Superfund Site and Areas South of Route 128

Dear Mr. LeMay:

In March 2005, the U.S. Environmental Protection Agency issued its Draft Final Multiple Source Groundwater Response Plan Remedial Investigation Report, hereinafter referred to as "MSGRP RI". In June 2005, the government issued its Draft Final Remedial Investigation/Feasibility Study, hereinafter referred to as "RI/FS," and a Proposed Plan for the Industri-Plex Superfund Site Operable Unit 2 and including Wells G&H Superfund Site Operable Unit 3 located in Woburn, Massachusetts, hereinafter referred to as "PP". The government indicated that it would accept comments on this proposal from July 1, 2005 to August 1, 2005. Despite numerous requests for further extensions, the deadline for comments was subsequently extended only to August 31, 2005.

The Aberjona River Study Coalition, Stauffer Management Company, Pharmacia Corporation f/k/a Monsanto Company by its Attorney-in-Fact Monsanto Company,[1] the Woburn City Council via the Honorable Edward J. Markey, The Honorable Edward J. Markey, State Senator Robert A. Havern, Cumming Properties by its General Counsel Susan F. Brand via The Honorable Kerry Healy and others requested extensions in time from the government to respond to the MSGRP RI, RI/FS and PP. The requests were summarily denied. Despite the EPA's taking years to issue its final reports, it gave interested parties an unreasonably abbreviated response period.

After review of the PP, in the middle of June, Pharmacia assembled a team of experts to prepare comments. These comments are attached to this letter along with an Alternative Remedial Action Plan, which we request that EPA adopt in lieu of EPA's Proposed Plan. The comments of counsel are also attached hereto. Three of the main points made in the experts' comments are worthy of highlighting here. First, the experts opine consistent with the EPA's own natural attenuation study, that the Halls Brook Holding Area retention system is functioning as designed and is sequestering and preventing downstream migration of contaminants. Second, the assumptions underlying the government's human health and ecological risk assessments are unrealistic and do not support the government's proposed remedies. (Early human health risk assessments 1995 and 1997 cited by the EPA in the RI/FS at ES-5 -- which are suspected to contain reasonable risk tolerances -- were not made a part of the administrative record.) Third, the PP remedies appear to have been improperly predetermined. *Motor Vehicle Manufacturers, Ass'n v. State Farm Mutual Automobile Ins. Co.*, 463 U.S. 29, 43, 103 S.Ct. 2856 (1983); *Penobscot Air Services, Ltd v. Federal Aviation Administration*, 164 F.3d 713, 719 (1st Cir.1999).

In 1989, following extensive investigation by the EPA, Old Monsanto and Stauffer, among other potentially responsible parties ("PRPs"), entered into a Consent

---

[1] The company known as Monsanto Company today was incorporated in 2000 by Pharmacia Corporation and subsequently spun off from Pharmacia Corporation. Pursuant to contractual arrangements between Pharmacia Corporation and Monsanto Company, Monsanto Company is acting as Pharmacia Corporation's attorney in fact with respect to this matter.

Decree regarding the Industri-Plex Site Operable Unit I (OU-1). Between 1989 and today, the PRPs have expended over eighty million dollars ($80,000,000) in remediation of the 245-acre Industri-Plex site. The successful remediation of the Industri-Plex site won second runner-up in the 2000 Phoenix Awards for EPA Region 1, and continues to be featured as one of the most successful Superfund site cleanups in the nation.

Nevertheless, the EPA's PP contemplates an additional twenty-five million dollar ($25,665,000) expenditure to remedy areas *outside* the Industri-Plex site.[2] The EPA's proposal is based on a faulty assessment that benthic organisms in the Halls Brook Holding Area (HBHA) Pond are currently at risk and on overly-conservative projections of future risks to human health. These risk assessments are speculative, unfounded, arbitrary and capricious as revealed by the comments of the experts. In addition to being driven by unrealistic risk assumptions, the remedies contained in the PP are also disproportionate to the risk.

As the comments enclosed herewith will demonstrate:

- the conclusions and recommendations reached in the EPA's PP do not conform to the physical evidence for the areas under investigation; and

- protection of public health and the environment would be achieved in an effective manner if the Alternative Remedial Action Plan were implemented instead of the EPA's Proposed Plan.

[2] Pharmacia does not concede that the EPA's jurisdiction extends beyond the Industri-Plex Superfund Site boundaries or that it has liability for any contamination wherever located; nor does Pharmacia concede that the designations OU-2 and OU-3 are valid legal descriptions.

If the EPA would like a more detailed submission regarding these issues, please let me know. I look forward to your response.

Very truly yours,

William L. Parker

William L. Parker

cc: John Beling, Esq. - USEPA
Andrew Cohen, Esq. - MADEP
Anna Mayor - MADEP
Gerald Rinaldi - Industri-Plex Site Remedial Trust
Cindy Brooks - Custodial Trust
The Honorable John Curran, Mayor, City of Woburn

COMMENTS BY PHARMACIA CORPORATION ON THE EPA'S MSGRP RI, MARCH 2005, RI/FS JUNE 2005, AND PROPOSED PLAN, JUNE 2005

Respectfully submitted,
Pharmacia Corporation

By Its Attorneys:

William L. Parker, Esquire
Barbara L. Horan, Esquire
Sonia L. Skinner, Esquire
Fitzhugh, Parker & Alvaro LLP
155 Federal Street, Suite 1700
Boston, MA 02110
(617) 695-2330

COMMENTS BY PHARMACIA CORPORATION ON THE EPA'S MSGRP RI, MARCH 2005, RI/FS OU-2, JUNE 2005, AND PROPOSED PLAN, JUNE 2005

In March 2005, the U.S. Environmental Protection Agency issued its Draft Final Multiple Source Groundwater Response Plan Remedial Investigation Report, hereinafter referred to as "MSGRP RI". In June 2005, the government issued its Draft Final Remedial Investigation/Feasibility Study, hereinafter referred to as "RI//FS," and Proposed Plan for the Industri-Plex Superfund Site Multiple Source Groundwater Response Plan Operable Unit 2 and including Wells G&H Superfund Site Aberjona River Study Operable Unit 3 located in Woburn, Massachusetts, hereinafter referred to as "Proposed Plan".

Pharmacia Corporation ("Pharmacia")[1] hereby submits comments in response to the Proposed Plan for cleanup of the Industri-Plex Superfund Site Operable Unit 2, including Wells G&H Operable Unit 3 (collectively the "Site") in Woburn, Massachusetts, proposed by the United Stated Environmental Protection Agency ("EPA"). In particular, Pharmacia submits herewith[2]:

1. Comments on the Draft Baseline Human Health Risk Assessment Report for the Multiple Source Groundwater Response Plan ("MSGRP"), Northern Study Area, Industri-Plex Superfund Site, Operable Unit 2 by Lisa JN Bradley, Ph.D. DABT, ENSR Environmental;

2. Comments on the Ecological Risk-Related Portions of USEPA's Proposed Plan for the Industri-Plex Superfund Site OU-2, Woburn Massachusetts, with associated figures and tables by Katherine Fogarty, P.E., LSP, Menzie-Cura & Associates;

3. Comments on USEPA's Proposed Plan Alternative HBHA-4 (Arsenic Removal during Groundwater to Surface Water Discharge) by Roger Olsen, CDM;

4. Comments on USEPA's Proposed Plan for Surface Water by Walter Eifert, Roux Associates;

5. Comments on USEPA's Proposed Plan for Sediments by Alan Fowler, Blasland, Bouck & Lee, Inc.;

---

[1] The company known as Monsanto Company today was incorporated in 2000 by Pharmacia Corporation and subsequently spun off from Pharmacia Corporation. Pursuant to contractual arrangements between Pharmacia Corporation and Monsanto Company, Monsanto Company is acting as Pharmacia Corporation's attorney in fact with respect to this matter.

[2] In submitting these comments, Pharmacia does not concede that the list of Potentially Responsible Persons ("PRPs") is complete and reserves its right to proceed against other PRPs, whether named or unnamed, for contribution, whose waste deposited at the site has caused a release of contaminants, pursuant to the discussion in *Acushnet Company, et als., v. Mohasco Corp., et als.*, 191 F.3d 69, 75 (1st Cir.1999).

6. Comments on USEPA's Proposed Remedy for the West Hide Pile by Lawrence McTiernan, Roux Associates;

7. Comments on USEPA's Proposed Plan for Monitoring by Lawrence McTiernan, Roux Associates; and

8. Alternative Remedial Action Plan.

The following comments rely upon and are in addition to the attached technical reports.

HUMAN HEALTH RISK

THE EPA IS BASING ITS PROPOSED PLAN ON OVERLY CONSERVATIVE AND SCIENTIFICALLY UNSUPPORTABLE HUMAN HEALTH RISK ASSESSMENTS OF UNREALISTIC FUTURE SCENARIOS.

The *only* current risk to human health identified in the EPA's Proposed Plan is the risk to recreational land users by ingestion of and dermal contact with arsenic and benzo(a)pyrene in near-shore sediments of the Wells G&H Wetland and Cranberry Bog. (FS, June 2005, at E-11). The remainder of the human health risk identified by the EPA is *future* risk to construction workers, industrial workers, car wash workers, recreational land users, and children in day care centers that might be located in those areas. Institutional controls are more than adequate to address these risks.

As explained by Lisa Bradley, the EPA's Plan overreaches to accommodate unnecessarily conservative, unrealistic estimates of human health risks that are vastly in excess of the reasonable maximum. (Combined Comments, at p. 4). In addition, the EPA's Plan is based on flawed calculations of Preliminary Remediation Goals (PRGs) for groundwater, soils, and sediments -- calculations that likely overestimate the risk to human health. (Combined Comments, at p. 28). Finally, as noted in Barbara Beck's prior submission, Industri-Plex Site Remedial Trust Comments on Risk Assessment Report, Recent Studies of Soil Ingestion Rate , hereinafter referred to as "ISRT Comments," the EPA's Proposed Plan is designed to protect scenarios that are highly unlikely to occur, either because they involve unrealistic assumptions about human behavior, or because institutional controls (including zoning regulations) already in place are designed to prevent these scenarios from developing. (ISRT Comments, at p. 37).

The EPA's Proposed Plan Is Arbitrary, Capricious, and Contrary to Law In Its Reliance On Overly Conservative, Unrealistic Or Erroneous Estimates Of Human Health Risk That Exceed The Reasonable Maximum.

The EPA calculated human health risks from soils, sediments and groundwater for both the central tendency (CT) and reasonable maximum exposure (RME) cases. (FS, June 2005 at pp. 1-25). CT calculations represent average risks and hazards. RME figures, used primarily in decision-making about *remediation*, represent upper-bound risks and hazards that are "reasonably expected to occur." (RI, March 2005, at p. 6-2). CT and RME risk figures are functions of estimates of exposure and toxicity. As noted by Dr. Bradley, the EPA employed statistical upper-bounds or even maxima for exposure parameters, and utilized EPA-derived toxicity values, themselves upper-bound values. (Combined Comments, at p. 6-7). The resulting estimates of human health risk vastly exceed the reasonable maximum. *Id.*

The most dramatic example of the EPA's overreaching methodology is the conclusion that arsenic in deep sediments in the HBHA Wetlands and Wells G&H Wetlands south of Route 128 poses an unacceptable human health risk to future dredgers. (Proposed Plan, at p. 3). As Dr. Bradley points out, the EPA adopted toxicity values for deep sediment by simply choosing the *maximum* arsenic concentration value at each of four sediment core locations, despite *significant variability among the values at each core* (e.g., choosing 150 mg/kg at SC01 where actual values were 150 mg/kg, 23 mg/kg, not detected and not detected). (Combined Comments, at pp. 18-19). The EPA also assumed the maximum exposure, i.e., that a dredging worker would remain at a single location for a two-year period and at each location would ingest the maximum detected concentration of arsenic at a very high sediment ingestion rate. In light of that erroneous assumption, the human health risk to future dredgers from contaminated sediments vastly overestimates the *reasonable* maximum risk. (Combined Comments, at p. 19; <u>See also</u> Letter from Barbara Beck to Joseph LeMay, August 29, 2005 at pp. 1-2). Any remediation plan based on such flawed methodology is, by definition, arbitrary and capricious.

Because the EPA regards arsenic contaminated sediments in deeper wetland areas to be "generally inaccessible to humans, with the exception of a future dredging worker," the EPA recommends long-term monitoring of surface water and sediment, together with institutional controls "to prevent or control potential exposures to arsenic-contaminated sediments during any potential future dredging of deeper sediments in the HBHA and Wells G&H Wetlands." (Proposed Plan, at p. 69). However, the EPA rejected its own recommendation for risks to current and future recreational users of the Wells G&H Wetlands and the Cranberry Bog, where the risk is tied to possible accidental ingestion of and dermal contact with near-shore or "accessible sediments." (FS, June 2005, at pp. 1-25). This decision is arbitrary and capricious in view of the EPA's *acknowledgment* that the use of institutional controls to prevent or control potential exposures to contaminated sediments, together with long-term monitoring of surface water and sediment "would provide protection from exposure to contaminated sediments...." (Proposed Plan, at p. 12).

Instead, the EPA proposes a $3,200,000 excavation and off-site disposal project to remove contaminated near-shore wetland sediments. The EPA's explanation for preferring this alternative is that it "provides the highest level of protection for human health because all contaminated sediments exceeding the cleanup standards would be removed." (Proposed Plan, at p. 12). This claim neither explains nor justifies the EPA's choice, and is especially arbitrary and capricious given that it was made using methods that overestimate the magnitude of human health risk, as argued above.

The EPA's Proposed Plan Is Arbitrary, Capricious, and Contrary to Law by Relying On Human Health Risk Assessments That Presume Future Uses That Are Prohibited by Existing Local Zoning Ordinances Or Are Otherwise Unrealistic.

With the exception of current recreational users, the EPA's human health risk assessment considers *future* risks to *hypothetical* individuals touching, ingesting, or inhaling contaminated soils, sediments, or groundwater. Despite the EPA's agreement (Proposed Plan, at pp. 3-6) that every human health risk in OU-1, OU-2 and Wells G&H OU-3 can be safely addressed by reasonable institutional controls, some of which are already in place, the EPA claims that a twenty-two million dollar engineering project is needed.

The City of Woburn withdrew its plans for nature trails and wetland boardwalks and piers in the Wells G&H Wetlands. (FS, June 2005, at pp. 1-25). Exposure of recreational users to contaminated sediment in these areas is an incomplete exposure pathway, and therefore should not be included in the EPA's human health risk assessment. (Combined Comments, at p. 10). Still, the EPA mechanically insists on a $3,200,000 excavation and off-site disposal of near-shore sediments *throughout* the Wells G&H Wetlands and Cranberry Bog because of arsenic exceedences at measuring stations located within remaining nature trail use scenarios. The fact that the EPA ignored uncertainty in upper concentration limits (UCLs) resulting from high variability in the EPA's measurements at these stations highlights the arbitrary and capricious character of the EPA's Proposed Plan. (RI, March, 2005 at pp. 6-10).

The EPA claims that its Proposed Plan is necessary to remedy various future risks to children who might attend future day care centers and to future industrial and commercial workers in OU-2 or Wells G&H OU-3. However, as Dr. Bradley points out, two of the future groundwater use scenarios contemplated by the EPA, the industrial worker's process water use and the car wash worker's shower use, are *already precluded by current zoning restrictions* on the installation and use of wells in Woburn. (Combined Comments, at p. 9). The EPA acted arbitrarily and capriciously by including these incomplete exposure pathways for groundwater thereby unjustifiably escalating the apparent human health risk.

The EPA's estimate of future risk to construction workers assumes that a construction worker working in a shallow excavation trench might ingest arsenic-contaminated groundwater at the same rate as a swimmer completely submerged in groundwater. (Combined Comments, at p 10). Furthermore, unlike the EPA's model, a realistic exposure scenario would acknowledge that a construction worker is likely to receive health and safety training that would significantly attenuate his or her reasonable maximum exposure to arsenic in groundwater. Similarly, the EPA's estimate of future risk to day care children ignores its own bioavailability data that show that the maximum relative bioavailability of arsenic is only 51%. (Combined Comments, at p 11). The EPA's use of sediment ingestion rates of 200 mg/day for a child and 100 mg/day for an adult is overly conservative. (ISRT Comments, at p. 37). The EPA's use of these overly conservative ingestion rates is arbitrary and capricious, especially in light of the 1997 Exposure Factors Handbook, which recommends soil ingestion rates of 100 mg/day for a child and 50 mg/day for an adult. USEPA. 1997b. Exposure Factors Handbook, Volume I. EPA/600/P-95/002Fa. Office of Research and Development. U.S. Environmental Protection Agency. Washington, D.C. More recent studies have concluded that the ingestion rates suggested by the EPA in 1997 are also overly conservative. Stanek and Calabrese (2000) performed a soil ingestion study of 64 children (ages 1 – 4 years) living on a Superfund site in Anaconda, Montana. Stanek and Calabrese derived a seven-day average soil ingestion rate for the 50th percentile child of 17 mg/day. The seven-day average soil ingestion rate for the 95th percentile child was 141 mg/day. Stanek, E.J. and E.J. Calabrese. 2000. Daily Soil Ingestion Estimates for Children at a Superfund site. *Risk Analysis* 20(5): 627-635. The EPA's use of the far more conservative estimates of soil ingestion is not supported by their own research, and is clearly arbitrary and capricious. The EPA's concern for possible risks to future children attending hypothetical daycare centers in OU-2 or OU-3 does not and cannot justify its arbitrary and capricious proposal of a $1.876 million dollar groundwater monitoring component "to ensure that contaminated soils left in place do not impact the groundwater and create unacceptable risks or hazards in the future," when institutional controls can be designed to prevent this risk. (Proposed Plan, at p. 4)

ECOLOGICAL RISK

THE EPA IS ACTING ARBITRARILY AND CAPRICIOUSLY BY BASING ITS PROPOSED PLAN ON AN ECOLOGICAL RISK ASSESSMENT THAT RESTS ON IRRELEVANT, SPECULATIVE AND FLAWED FACTUAL AND TECHNICAL ASSUMPTIONS.

The EPA's Proposed Plan identifies "significant ecological risks in HBHA [Halls Brook Holding Area] Pond." (Proposed Plan, at p. 3). The EPA also claims "the arsenic plume contributes to downstream migration." *Id.* The EPA's conclusion that a pond intercept in HBHA Pond, combined with groundwater treatment and in-situ enhanced bioremediation at the West Hide Pile, are needed to mitigate these ecological risks is completely unjustified. The EPA's ecological risk assessment ignores critical facts about the Halls Brook Holding Area (HBHA) Pond, and disregards its own data on toxicity to benthic organisms and its own analyses of ecological risk. The EPA's ecological risk assessment fails to acknowledge the relevance of National Recommended Water Quality Criteria (NRWQC), and of Massachusetts Wetlands Regulations, 310 C.M.R. § 10.01(2).

The EPA's decision to implement preferred alternatives GW-2 (Pond Intercept with Monitoring and Institutional Controls) and GW-4 (Plume Intercept by In-Situ Groundwater Treatment and Monitoring with Institutional Controls) to address this unjustified assessment of ecological risks in HBHA Pond is arbitrary and capricious.

The EPA's Ecological Risk Assessment Ignores Critical Facts About Halls Brook Holding Area (HBHA) Pond.

HBHA Pond was designed and constructed as part of a commercial development project as a storm water retention area and control structure. Its purpose is to manage water flows during storm conditions. As Katherine Fogarty explains, the deep, narrow design of HBHA Pond causes thermal stratification during the summer months. (Combined Comments, at p. 30). As a result, the hypolimnion (bottom layer) becomes anoxic. According to the USEPA's own guidance document, Lake and Reservoir Bioassessment and Biocriteria, Technical Guidance Document, Office of Wetlands, Oceans, and Watersheds, Office of Science and Technology, Office of Water, 2003 (http://www.epa.gov/owow/monitoring/tech/lakes.html), ("LRBB"), the benthic invertebrate community in the hypolimnion of stratified lakes and ponds is typically impoverished and, in persistent anoxic conditions, can be completely absent. It is no surprise that the EPA's sampling of HBHA Pond showed the benthic invertebrate community there to be minimal. EPA's *reference* pond displayed similar characteristics. (Baseline Ecological Risk Assessment (BERA), at Table 42). The anoxic conditions at HBHA Pond combine with other natural features of the site, e.g., lack of extensive shallow areas for spawning and lack of submerged aquatic vegetation for foraging and protection from predators, to reduce the suitability of the habitat for recreational species of fish. (Combined Comments, at p 34). Moreover, according to Ms. Fogarty, at the W.R. Grace Superfund Site in Acton, Massachsuetts, the EPA recognized that remediation of arsenic-contaminated sediments below the thermocline would not improve the habitat for benthic invertebrates, because the abundance and diversity of these species will be limited by the seasonal anoxia in the hypolimnion. (Combined Comments, at p. 31. See USEPA's (2005) Preferred Alternative for Cleanup of Sinking Pond on the W.R. Grace Superfund Site in Acton, Massachusetts). The EPA proposes a $7.7 million dollar remedy for HBHA Pond without providing adequate justification for the departure from its own Region I standards and without explaining its unsupported insistence on a remedy in Woburn that it found unnecessary in Acton.

The EPA's Ecological Risk Assessment Disregards Its Own Data On Toxicity to Benthic Organisms.

HBHA Pond is an engineered structure that was introduced to a commercial area to control storm water flows. It was neither designed nor intended to serve as a viable wetland habitat. Ms. Fogarty explains how the seasonal thermal stratification, coupled with the resulting anoxia in bottom waters, creates an environment that is poorly suited to an abundant and diverse benthic invertebrate community. (Combined Comments, at p. 31). It is worthy of note that stratified lakes and ponds that are completely free of contaminants exhibit these conditions. Thus, it is the inherent nature of the stratified lake or pond that renders sediments below the thermocline of minimal benefit to the benthos. As such, the abundance and diversity of this benthic population would be minimal in the HBHA Pond even if it were completely free of contaminants. (Combined Comments, at p. 31). The EPA's decision that the risk to benthic invertebrates that inhabit this geo-engineered structure mandates the implementation of a three-part, $7.7 million dollar remedy is arbitrary and capricious.

In selecting a Preliminary Remediation Goal (PRG) for the protection of benthic invertebrates at HBHA Pond, the EPA arbitrarily chose the lowest concentration of sediment arsenic (273 mg/kg) at which toxicity effects were observed in these organisms. (FS, June 2005, at p. 2-21). The site in HBHA Pond that had an arsenic concentration of 273 mg/kg and toxic effects on the benthos was SD-MC-06, a shallow water site. (BERA, at pp. 125-126; see also FS, June 2005, at pp. 2-21). The EPA completely ignored data from another HBHA shallow water site (SD-MC-11) where, despite an arsenic concentration of 1,200 mg/kg, benthic survival and growth rates were *higher* than at SD-MC-06. (BERA, Appendices 7B.3 (sediment) and 7B.10 through 7B.13 (toxicity results)). The EPA also disregarded data indicating that toxicity to benthic invertebrates in sediment was related to iron-arsenic ratios in sediment rather than to arsenic concentrations. (BERA, at p. 140). In downstream areas with similar iron-arsenic ratios and higher arsenic concentrations, *no toxic effects* on benthic invertebrates were observed. (BERA, Appendix 7B.15). The questionable choice of a benchmark of 273 mg/kg rather than 1,200 mg/kg as a PRG for arsenic in HBHA Pond is completely arbitrary. It is appallingly apparent that the EPA collected data indicating that arsenic might have less effect on the benthic population, but then subsequently ignored this data when selecting the PRG. A pattern of selective, arbitrary and capricious behavior also emerges when one considers that the EPA further ignored data suggesting that iron, which is abundant in HBHA Pond sediment, renders arsenic less toxic to benthic invertebrates than the EPA estimated. There is no question, in view of these facts, that the EPA's recommendation of further remediation of HBHA Pond is arbitrary and capricious.

The EPA's Ecological Risk Assessment Completely Disregards Its Own Analyses Of Ecological Risk.

The EPA ignored most of the in-depth statistical analyses it performed in selecting a meaningful PRG for the protection of benthic organisms in HBHA Pond. It failed to utilize available information that strongly suggests that there is a negligible correlation between sediment arsenic concentration and a decreased benthic population. (BERA, Appendix 7D). The EPA arbitrarily and unjustifiably disregarded its own findings indicating that features of the habitat, e.g., acid volatile sulfide sediment concentration, water depth, dissolved oxygen content of the overlying water, flow regime and total organic carbon, have a *far greater* impact on the benthic invertebrate population in HBHA than arsenic concentration. (BERA, Appendix 7D). Instead of utilizing the aforementioned data, the EPA used only toxicity data from HBHA Pond, despite evidence from its own multivariate analyses that the two deep water sites were not representative of HBHA Pond sites, to "justify" its choice of arsenic toxicity as the basis of the PRG for the protection of the benthic community. (FS, June 2005, at pp. 2-21). The EPA ignored its own evidence demonstrating that factors such as: acid volatile sulfide concentrations in sediment; water depth; dissolved oxygen content of the overlying water; flow regime; and total organic carbon, have a far greater negative impact on the benthos than sediment arsenic. (BERA, Appendix 7D). The EPA's proposal to implement a $7.7 million dollar remediation of arsenic contamination, despite evidence that many other features of the habitat can have a significant adverse impact on the benthic community, is arbitrary and capricious.

The EPA's Ecological Risk Assessment Completely Ignores the Relevance Of National Recommended Water Quality Criteria (NRWQC).

As Ms. Fogarty points out, the EPA's proposed remedy of a pond intercept with monitoring and institutional controls, combined with a plume intercept in-situ groundwater treatment and monitoring program with institutional controls, is driven by a risk assessment that shows that oxygenated surface water in and flowing from the HBHA Pond is in compliance with EPA's own National Recommended Water Quality Criteria (NRWQC) for arsenic. (BERA, Appendix 7B.2; see also Combined Comments, at p. 33). Despite taking 461 surface water samples from HBHA Pond, under both baseflow *and* storm conditions, the EPA was unable to find *any* samples in which dissolved arsenic in surface water above the oxic/anoxic interface or flowing from HBHA Pond exceeded NRWQC. (BERA, Appendix 7B.2). Dissolved arsenic concentrations were in excess of the NRWQC *only* in water below the oxic/anoxic interface. (RI, March 2005, Appendix 2D). As Ms. Fogarty explains, when water high in dissolved ferrous iron and dissolved arsenic reaches this interface, the presence of oxygen converts ferrous iron to ferric iron, which precipitates as iron hydroxide floc and sequesters arsenic, thus keeping arsenic out of the oxygenated surface water. The dissolved arsenic concentrations that exceed NRWQC are restricted to the anoxic bottom water. (Combined Comments, at p. 33). This suggests that HBHA Pond is itself performing the desired detoxification by continually sequestering arsenic from the lower anoxic waters. Surface water above the thermocline does not contain excess dissolved arsenic due to the high oxygen concentration, and dissolved arsenic is not being transported out of HBHA Pond in excess of NRWQC. The EPA's Proposed Plan, which recommends the expenditure of $7,700,000 to finance a remedy that occurs naturally within the HBHA Pond is, by definition, arbitrary and capricious.

The EPA's Ecological Risk Assessment Disregards The Relevance Of Massachusetts Wetlands Regulations, 310 C.M.R. 10.01(2).

The EPA's Baseline Ecological Risk Assessment ignores the success of HBHA Pond in protecting wetland interests outlined by Massachusetts Wetland Regulations, 310 C.M.R. 10, which are Applicable or Relevant and Appropriate Requirements (ARARs) for the site and which any remediation plan EPA proposes must satisfy. The HBHA Pond, *in its current condition,* provides the following benefits: 1) it protects public and private water supplies and groundwater supplies; 2) it provides flood control and storm damage prevention; 3) it prevents pollution; and 4) it provides protection for fisheries and wildlife habitats. (Combined Comments, at p. 34). The anoxic floor of HBHA Pond biodegrades benzene. The Pond serves as an effective arsenic sink preventing arsenic from migrating downstream. HBHA Pond was designed as a storm water retention area and control structure to manage water flows during storm conditions and is performing its intended function. The overall poor quality habitat, which the EPA acknowledges is *unrelated* to the presence of arsenic, does not support recreational species of fish in HBHA Pond; however, because of its design, HBHA Pond protects richer habitats downstream that do support fisheries. (BERA, Appendix 7B.7; see also Combined Comments, at p. 34). The overly narrow rationale of the EPA's Proposed Plan defies both science and logic, and represents an arbitrary, capricious, scientifically unsupported, and needlessly expensive effort to disturb a successful ecological system.

PROPOSED REMEDIES

THE EPA'S PROPOSED PLAN TO REMEDY ARSENIC CONTAMINATION IN HBHA POND SEDIMENTS IS FATALLY FLAWED AND SHOULD NOT BE IMPLEMENTED.

The "remedy" the EPA proposes for arsenic in sediment, preferred alternative HBHA-4, requires dismantling the arsenic-capture/retention basin (HBHA Pond) and disruption of the downstream wetlands. The HBHA Pond and wetlands form a hydrologic system that efficiently captures and sequesters arsenic from surface and ground water, preventing its downstream migration. This system works *better* than planned, and, according to Roger Olsen, "pond sediments will continue to remove arsenic for several hundred years." (Combined Comments, at p. 38). Moreover, as explained in detail by Alan Fowler, the dredging the EPA proposes is not an effective risk-reduction technology, will not create a viable habitat for benthic organisms in HBHA Pond, and because the EPA has underestimated the amount of sediment to be removed, is likely to be nearly twice as expensive as the EPA estimates. (Combined Comments, at p. 49). He cautions that the EPA's HBHA-4 alternative, if implemented, is likely to *increase* the extent of arsenic contamination. (Combined Comments, at p. 48).

The irony in the EPA's recommendation of alternative HBHA-4 is that there are *no current human health risks* that require this alternative. As argued above, ecological risks to the benthic community are not compelling, because an abundant and diverse benthos is unlikely in the anoxic basin of HBHA Pond. The future risks to be addressed by the EPA's $9.187 million dollar dredging of HBHA Pond can be completely managed by institutional controls.

The EPA's recommendation of alternative HBHA-4 proposes an ineffective alternative to a contaminant problem that is currently being effectively managed by a natural remedy according to EPA's own Natural Attenuation Study. Ford, Natural Attenuation Study, Industri-Plex Superfund Site, September 2, 2004 ("NAS"). It would be arbitrary, capricious and contrary to law to implement the EPA's proposed alternative.

The Two Arsenic-Removal Mechanisms Currently in Place Continue to Effectively Capture and Precipitate Arsenic In HBHA Pond.

As Olsen explains, two sorption ("take-up") mechanisms are currently at work in HBHA Pond to remove arsenic. (Combined Comments, at p. 37). The first is sorption to hydrous iron oxides produced by iron oxidation and precipitation. At the oxic/anoxic transition in the Pond, reduced iron is oxidized. Hydrous ferric oxides form and adsorb arsenic dissolved in the water column, where it precipitates out of the water, coming to rest in the sediment. The second arsenic removal mechanism is sorption to pond sediments. (Combined Comments, at p. 38). Sediments rich in iron, sulfur and organic matter sequester arsenic at the sediment-water interface.

The oxic-anoxic interface in HBHA Pond, sometimes called the "chemocline," is critical to the operation of both mechanisms. The EPA's concern is with the stability of this chemocline during storm events. (FS, June 2005, at p. 3-29). The EPA envisions sudden increases in flows, for example, as might be observed during storm events, mixing the water column, breaking down the chemocline, disrupting the arsenic removal mechanisms at work in the Pond, and allowing arsenic to be flushed downstream. However, as Olsen points out, *actual data* show that the chemocline is *not* being broken up during storm events. For example, Olsen reports on measurements taken after the March, 2001 storm, a 5.31" precipitation event, indicating that the oxic zone may have occurred at a slightly greater depth in the pond because of the addition of surface water runoff (an advantage, as Olsen notes), but that the critical oxic-anoxic transition remained intact. According to Olsen, "[t]he overall break down of the chemocline has been overstated in the FS." (Combined Comments, at p. 37). Furthermore, although the MSGRP (RI, March 2005) reported "a major surface runoff event" that "resulted in turnover of most of the pond volume and depression of the chemocline at the north end of the pond," *the chemocline was not broken down,* but only depressed (i.e., occurred at a greater depth). (RI, March 2005, at pp. 5-34). The EPA's recommended alternative for remedying arsenic contamination of HBHA Pond sediments is unnecessary in view of the continued, robust effectiveness of the sorption of arsenic to hydrous iron oxides.

The EPA is also apparently concerned that there is only "incomplete removal onto sediments," and that the "long-term capacity of the HBHA Pond" is unknown. (NAS, at p. 39). However, as Olsen explains, recent evaluations of pond sediments confirm a high iron content that is capable of adsorbing arsenic for many years. Additional input of suspended solids with iron containing minerals via Halls Brook and other flows during normal and high flow events provide additional adsorption sites and an arsenic removal capacity. According to Olsen, "conservative estimates" using the results of the Supplemental Site Investigation Report, Industri-Plex Site, September 1997, indicate that "the pond sediments will continue to remove arsenic for several hundred years." (Combined Comments, at p. 38). Therefore, the EPA's conclusions are incorrect and do not support abandoning the remedy currently in place.

The EPA's Proposed Dredging of HBHA Pond And Lining The New Boston Street Drainway Will Destroy Effective Arsenic-Removal Processes.

Olsen cautions that the EPA's proposed removal of sediments from HBHA Pond will destroy an effective and important arsenic removal process because existing pond sediments function in one of the two basic arsenic removal mechanisms in the Pond. (Combined Comments, at p. 38). "This process should be maintained and not disturbed by dredging." Id. Furthermore, according to Olsen, because it is inappropriate to remove HBHA Pond sediments, the installation of a liner in the New Boston Street Drainway to prevent arsenic containing sediments from entering the Pond is unnecessary and will *reduce* the effectiveness of the remedy, as the lining cuts off a source of iron-containing minerals critical to the hydrous iron sorption of arsenic from Pond water.

The EPA's Proposed Plan to Remediate Sediments Will Be Less Effective And More Expensive Than The EPA Acknowledges.

The EPA preferred alternative for sediment contamination, HBHA-4, includes the reduction of arsenic-containing sediment by dredging the southern end of HBHA Pond. However, as Alan Fowler argues, dredging is *not* an effective risk-reduction technology. (Combined Comments, at p. 48). As argued above, future risks to human health can be *minimized* by the remedy currently in place, together with appropriate, available institutional controls.

Finally, according to Fowler, the proposed project is likely to be twice as expensive as the EPA estimates, because, according to Fowler, the EPA has underestimated by as much as 50% the amount of sediment it will have to dredge from the HBHA Pond. (Combined Comments, at p. 49). It is arbitrary and capricious for the EPA to proffer a remediation plan without addressing each of the aforementioned issues. For each of the foregoing reasons, the EPA's Proposed Plan to dredge the HBHA Pond should not be implemented.

THE EPA'S PROPOSAL OF A SURFACE WATER REMEDY FOR OU-2 THAT WILL REPLACE A SUCCESSFUL CONTAMINANT MANAGEMENT SYSTEM WITH A LESS EFFECTIVE SYSTEM LIKELY TO INCREASE DOWNSTREAM FLOODING IS ARBITRARY AND CAPRICIOUS.

According to Walter Eifert of Roux Associates, the EPA's Proposed Plan to address contamination from arsenic in the deep surface water of HBHA Pond is a hasty, ill-conceived, short-sighted proposal that very likely will be *less effective* at containing and sequestering arsenic than the one currently in place. (Combined Comments, at p. 41). The EPA's surface water plan is to "monitor" the Pond for effects of a thirteen-million dollar engineering project involving a pond *intercept*, partial pond *dredging*, and pond *relocation*. The EPA's planned disruption of the Pond's carefully engineered hydrogeology will almost certainly result in *increased* downstream transport of arsenic. Moreover, because the EPA has not even evaluated its proposal for flooding effects, the effect of the proposed remedies on downstream flooding is unknown; however, there are strong indicators that flooding may increase as well. (Combined Comments, at p. 45).

There are no human health risks currently posed by surface water in HBHA Pond. Also, as discussed above, ecological risk to aquatic and benthic communities in HBHA Pond is illusory. The EPA's plan to remediate the deep surface water will not restore aquatic communities whose abundance and diversity are diminished by naturally occurring features of the habitat. (Combined Comments, at p. 31 and p. 48). The HBHA Pond is performing its intended functions as a storm water retention basin and contaminant capture and sequestering system, and in fact, is showing a capacity for managing larger storm water flows than planned. The EPA's proposed dismantling of a carefully planned and engineered solution whose performance exceeds expectations, and substitution with an inferior system with potentially disastrous consequences, to remedy a non-existent risk to benthic invertebrates, is arbitrary and capricious.

The EPA's Proposed Surface Water Remedy Is Arbitrary And Capricious Because It Will Likely Reduce The Arsenic-Removing Capacity Of HBHA Pond And Increase The Downstream Transport Of Arsenic.

Because of the extensive re-engineering of the HBHA required by the EPA's proposal to "correct" contamination of deep surface water in HBHA Pond, the EPA's Proposed Plan will completely disrupt the successful remedy now in place. Even the EPA acknowledges that the current remedy, which is comprised of a long, narrow, deep pond and a series of wetlands, all on a flat hydraulic grade, has been successful at capturing and sequestering arsenic. (Combined Comments, at p. 40). Surface water currently poses no risk to human health; the risk to aquatic organisms from arsenic and benzene plumes is non-existent because the natural environment of HBHA Pond is not hospitable to benthic invertebrates or recreational fish.

As Walter Eifert explains in his comments, the success of the HBHA system as an arsenic-removal mechanism is largely the result of HBHA's specially designed hydrogeology, which enables it to sequester arsenic and minimize its downstream transport. (Combined Comments, at p. 40). Nevertheless, the EPA proposes to dredge the southern portion of HBHA Pond and force the remaining northern half to perform all of the system's current arsenic retention and transport mitigation functions. Because it will significantly alter the hydrogeology of the HBHA Pond basin, the partitioning of HBHA Pond required by the EPA's Proposed Plan will very likely *reduce* the area's arsenic recovery potential. (Combined Comments, at p. 41). In particular, the proposed re-engineering of HBHA Pond will allow *increased* sediment delivery downstream during storm events as storm flows scour the basin and flush sediments out of the Pond. (Combined Comments, at pp. 41-42). The shorter length-to-width ratios created by the EPA's proposed Coffer dam partitioning of the Pond will also significantly reduce the settling efficiency of the system and in turn, increase the flow of arsenic-containing materials downstream.

The arsenic-removing capacity of HBHA Pond will be further reduced by that part of the EPA's Proposed Plan that calls for *diverting* the flow of Halls Brook from the smaller, northern basin. (Combined Comments, at pp. 43-44). Halls Brook currently delivers iron-rich sediments to the Pond that are an important component of its capacity to remove arsenic from groundwater. In addition to reducing iron reaching the Pond, the proposed diversion of Halls Brook would eliminate oxygenation that is critical to the Pond's ability to sequester arsenic. The EPA's Proposed Plan will be *less effective* at removing arsenic from groundwater than the remedy currently in place. (Combined Comments, at pp. 43-44). As a consequence, the EPA's Proposed Plan is arbitrary and capricious and must be rejected.

The EPA's Proposed Plan is Arbitrary And Capricious Because The Proposed Construction Of Coffer Dams Will Increase Flooding, A Problem The HBHA Pond And Wetland System Was Developed To Address.

The HBHA Pond and Wetland system was constructed in the early 1970's as a flood control project to replace the filled in Mishawum Lake. The hydraulic design of the system results in very low flow velocities for storms of up to 100-year recurrence frequency. Very low flow velocities during storm conditions are due to the bathtub-like design of the pond (long and narrow with steep sides and a high inlet and outlet), the flat hydraulic grade of the wetlands, and flow restrictions at the Mishawum Road outlet. (Combined Comments, at p. 44).

The HBHA was constructed to decrease flooding incidents in Woburn and Winchester and has been successful in that regard. The HBHA also sequesters and deposits arsenic in the sediment. The EPA plans to install Coffer dams that will partition the HBHA into north and south basins, thereby shortening the length-to-width ratio of each basin. In a storm event, the shortened length-to-width ratio is likely to significantly and adversely affect the settling capacity of fine-grained sediments, thereby increasing sediment delivery downstream. (Combined Comments, at pp. 41-42). The EPA's Proposed Plan is arbitrary and capricious as it omits any evaluation of the effects of sediment transport as a consequence of the government's proposal.

The EPA's Proposed Plan is Arbitrary And Capricious Because It Fails To Consider The Potential For Flooding Effects.

The EPA's Proposed Plan will significantly alter the hydrogeological features of the HBHA. The EPA has not evaluated the effects its proposed alterations will have on flooding upstream or downstream of the Coffer dams and Halls Brook bypass. However, increased inflow velocities, combined with a reduction in storage volume as a result of the Coffer dam partitioning of the Pond, and an increase in the 100-year peak inflow rate caused by commercial development in the area, will almost certainly worsen downstream flooding. (Combined Comments, at pp. 44-45).

The installation of Coffer dams at two locations in the northern portion of HBHA Pond will isolate forty per cent (40%) of the Pond from Halls Brook inflows, but will expose it to surface water inflows from a drainway on Atlantic Avenue and a culvert draining a business park area. The effect of the proposed Coffer dam partitioning on flooding in these areas is unknown and unevaluated, despite the availability of a recent (2003) study of the hydrologic/hydraulic conditions along Middlesex Canal and Halls Brook commissioned by the Army Corps of Engineers, and an ongoing study of flooding conditions along the Aberjona River commissioned by FEMA. (Combined Comments, at pp. 44-45). These studies indicate that downstream areas are likely to experience an *increase* in flooding as a result of the diminished storage capacity of the Pond. The EPA's remedy, proposed in the absence of data on the expected hydraulic performance of its Proposed Plan, and given other data that the HBHA system as currently designed is *exceeding* expectations of its flood-mitigation capacity, is one more indication that the EPA's Proposed Plan is an arbitrary and capricious recommendation that should not be implemented.

THE EPA'S PROPOSED PLAN TO DREDGE ARSENIC-CONTAINING SEDIMENTS IN WELLS G&H WETLANDS AND CRANBERRY BOG IS ARBITRARY AND CAPRICIOUS.

The EPA proposes to excavate and remove near-shore sediments in the Wells G&H Wetland and Cranberry Bog in order to treat arsenic contamination there. It can be assumed that the EPA's recommendation of alternative NS-4, Removal and Off-Site Disposal, suffers from the drawbacks of dredging HBHA Pond, discussed above. (Combined Comments, at p. 48). Moreover, the EPA's risk assessment driving this remedy is based on unrealistic assumptions as discussed by Dr. Bradley in her comments. (Combined Comments, at pp. 18-19). Current risk to recreational users is already under EPA's control and any future risk to recreational users and/or dredgers can be completely managed through well-planned institutional controls. In view of these facts the EPA's recommended solution is arbitrary and capricious.

THE EPA'S PROPOSED PLAN TO REMEDIATE THE WEST HIDE PILE IS ARBITRARY, CAPRICIOUS, AND CONTRARY TO LAW.

According to Lawrence McTiernan of Roux Associates, the EPA's proposed $3.75 million dollar in-situ enhanced bioremediation of the West Hide Pile in OU-1 is unnecessary and is likely to be highly ineffective. (Combined Comments, at pp. 52-53). Any future human health risks to industrial and construction workers can be addressed through institutional controls (Combined Comments, at p. 52). There are no unacceptable ecological risks in OU-1 attributable to benzene in groundwater at the West Hide Pile, as the EPA admits (Combined Comments, at p. 52; see also FS, June 2005, pp. 1-23 and 1-30). In the absence of any chemical-specific ARARs for Site groundwater, the EPA's proposed remediation of the West Hide Pile is unnecessary. (FS, June 2005, Section 2.1.1).

Finally, *any* further remediation of OU-1 must be approved by the federal court that retains jurisdiction over OU-1 and the Consent Decree. The EPA's attempt to unilaterally alter the terms of the consent decree is contrary to law.

THE EPA'S PROPOSAL FOR LONG -TERM MONITORING OF PLAN EFFECTIVENESS IS ARBITRARY, CAPRICIOUS, AND SHOULD NOT BE ADOPTED IN ITS CURRENT FORM.

Having initially acknowledged that a multi-media monitoring system is preferred, the EPA now arbitrarily and capriciously recommends an overly broad, disjointed, medium-specific monitoring plan. (FS, June 2005, Appendix B tables). As explained by Lawrence McTiernan, the EPA's proposed monitoring plan inefficiently and ineffectively focuses on individual media and ignores the interdependent nature of the proposed remedies. (Combined Comments, at pp. 55-56). For example, despite the Proposed Plan's focus on HBHA Pond, where there will be *sediment* sampling at 20 locations, the recommended monitoring plan calls for 30 to 50 monitoring stations in the Wells G&H area, and 10 surface water sampling locations along the Aberjona River. (Combined Comments, at p. 55-56).

Due to its lack of focus, the EPA's proposed monitoring plan will generate data that are *meaningless* for assessing the effectiveness of its proposed remedies (Combined Comments, at p. 56). For example, many groundwater and surface water stations will monitor changes in contaminant concentrations in areas that are not now at risk and that will have little or no impact on the effectiveness of the proposed remedies. Other stations will collect data (e.g., on semivolatile organic compounds) that are *useless* for assessing the effectiveness of the EPA's proposed remedial actions. (Combined Comments, at p. 56).

In addition, the EPA recommends a monitoring plan be executed quarterly or semi-annually, a monitoring schedule that is more appropriate for assessment phases than for long-term monitoring. (Combined Comments, at p. 56). It is arbitrary and capricious for the EPA to recommend such an irrational, ill-conceived, ineffective monitoring plan. It would be foolhardy to implement it.

BREVITY OF COMMENT PERIOD AND RIGHT TO SUPPLEMENT RECORD

Pharmacia reserves the right to supplement the record upon which EPA's final remediation decision is to be based, in view of the arbitrarily brief comment period. Given the complexity and far-reaching consequences of the EPA's Proposed Plan, the relatively short comment period allowed by the EPA precluded an in-depth review and analysis of the EPA's recommendations, pre-empted full and fair public participation in a discussion of its recommendations, and foreclosed any meaningful opportunity for all interested parties to confer to determine the appropriate remedy.

RESERVATION OF CONSTITUTIONAL RIGHTS

Pharmacia notes for the record that the application of CERCLA to create remediation obligations in Pharmacia would effect an unconstitutional taking of Pharmacia's property in violation of the Takings Clause of the Fifth Amendment to the United States Constitution. *Eastern Enterprises v. Apfel*, 524 U.S. 498, 523 (1998) (plurality opinion). Pharmacia further notes for the record that, insofar as the EPA's Proposed Plan constitutes impermissible retroactive legislation, it violates the substantive due process rights guaranteed to Pharmacia under the Fifth Amendment. *Id.* Pharmacia hereby reserves it rights under the United States Constitution.

Comments on USEPA's June 2005 Proposed Plan

Multiple Source Groundwater Response Plan Study Area

Woburn, Massachusetts

August 31, 2005

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1.0 Comments on Human Health Risk Assessment

This section presents ENSR International's comments on the Draft Baseline Human Health Risk Assessment Report for the Multiple Source Groundwater Response Plan (MSGRP) Northern Study Area (the MSGRP HHRA) (USEPA, 2005a). Many issues were identified, and the comments focused on the scenarios and constituents that are the risk-drivers and therefore formed the basis for the Feasibility Study (FS) and Proposed Plan.

USEPA Risk Characterization Guidance discusses the importance of the "core values of transparency, clarity, consistency, and reasonableness" in risk assessments, and stresses that assumptions used should fall within a "zone of reasonableness" (USEPA, 1995a). The MSGRP HHRA has not been conducted consistent with these guidelines and has used unrealistic exposure scenarios and overly-conservative exposure parameters. This risk assessment should serve only as an interim step in the evaluation of risks potentially posed by the site. Once the risk drivers were identified, the exposure scenarios should have been reviewed and re-evaluated using more realistic and reasonable exposure scenarios and assumptions. As discussed in detail below, the combination of several upper bound assumptions serves only to overly exaggerate risk; any single upper-bound assumption coupled with more reasonable assumptions will still result in upper-bound risk estimates. Therefore, USEPA should not make risk management decisions and propose remedial actions until the HHRA is revised to use a more realistic and reasonable approach, as detailed below:

Exposure to Groundwater

- **The use of groundwater in a car wash scenario should not have been included in the risk assessment as a complete exposure pathway based on City of Woburn zoning and groundwater use restrictions.**
- **Future use of groundwater as industrial process water should be identified as an incomplete pathway, and no risks or hazards should be calculated for this scenario, because special permits are required for well installation in Woburn and wells can not be installed on hazardous waste sites.**
- **Ingestion of shallow groundwater during excavation activities should not be identified as a complete exposure pathway, and no risks or hazards should be calculated for this pathway because a construction worker will not ingest shallow groundwater at a rate of 50 ml per day, which is the high intensity water ingestion rate assumed for a swimming scenario.**
- **Considering reasonable future use of groundwater, the potential for vapor intrusion, and the potential for future excavation and construction work within the MSGRP Northern Study Area, no groundwater exposure pathways result in risks or hazards above regulatory guidelines. No remedies for groundwater need to be addressed in either the FS or the Proposed Plan.**

Exposure to Soil

- **Use of the more realistic, yet upper-bound, soil ingestion rate of 100 mg/day for the construction worker would result in a 2-fold reduction in risk and hazard estimates for this pathway. Coupled with the use of the arsenic bioavailability factor for soil ingestion (resulting in an additional 2-fold reduction in ingestion risk and hazard estimates), and elimination of the shallow groundwater ingestion pathway, the resulting potentially carcinogenic risks would not exceed the regulatory guidelines for the construction worker, and the hazard index would be only slightly above the regulatory guideline of 1 for the SO (Former Mishawum Lake and associated wetlands) subsurface soil exposure area, and would be below the regulatory guideline for the SO surface soil exposure area.**

- Excavation restrictions for construction workers exposed to subsurface soils in the SO area should be based on a 1,000 mg/kg PRG for arsenic, which was derived using more realistic, yet still conservative, exposure factors than used by USEPA.

- Application of more realistic and reasonable exposure parameters for a future day care child assumed to be exposed to arsenic in surface soils in the SO area would result in a hazard index that is below regulatory guidelines. Since the potential carcinogenic risk level is already below regulatory guidelines, no remedial action would be necessary or appropriate for surface soils.

- USEPA's hazard index and potential carcinogenic risk estimates for a future day care child exposed to subsurface soils in the SO area are based on the highly unrealistic assumption that all of the subsurface soil in the study area would one day be brought to the surface and that the 95% upper confidence limit (UCL) concentration would occur precisely in a child's play area. If USEPA's exposure assumption is correct, there should be little or no difference in surface and subsurface soil concentrations as a result of development. However, this is not the case. The majority of the property in the study area is developed, i.e., already subjected to construction and reworking of subsurface soils, yet the subsurface soils (Exposure Point Concentration (EPC) = 1,900 mg/kg) still have higher concentrations than surface soils (EPC = 92 mg/kg). For this reason, this exposure pathway should be considered incomplete.

Exposure to Sediments

- To identify a hazard index and a potential carcinogenic risk above regulatory guidelines, USEPA had to assume that a dredger worked at single location in HBHA Pond for a two-year period and ingested the maximum detected concentration of arsenic at that location at a very high sediment ingestion rate. The resulting exposure point concentration (EPC) for the future dredger scenario is unreasonable, unrealistic and does not reflect the scenario evaluated. Arsenic concentrations, which are the risk driver, are highly variable. It is likely that if the more realistic exposure assumptions and EPCs are used in the MSGRP HHRA, risks for this hypothetical future dredger receptor would not exceed regulatory guidelines. For that reason, risk management decisions should not be made for sediments until the HHRA is revised using more realistic exposure assumptions.

Arsenic Toxicity

- Based on this review of the available scientific data (including numerous studies that have been published since the RfD was last revised), use of a diet-adjusted NOAEL of 0.0024 mg/kg-day (reflecting a NOAEL of 0.0015 mg/kg-day and a dietary intake of 0.0009 mg/kg-day) together with an MOE of 1 represents a conservative (i.e., health-protective) toxicity benchmark (RfD = 0.0024 mg/kg-day) for assessing potential non-cancer health risks associated with long-term exposures. This RfD is 8-fold higher that that developed by USEPA. Use of this value would result in an 8-fold decrease in the calculated hazards in the MSGRP HHRA and would result in an 8-fold increase in the noncancer-based PRGs for arsenic.

- The uncertainties, and high degree of conservatism, in the cancer potency estimates for arsenic provide an additional reason why the MSGRP HHRA should be refined with more realistic exposure assumptions prior to using it as the basis for remedy decisions.

Trichloroethylene Toxicity

- Lewandowski and Rhomberg (2005) recently published an analysis of the USEPA TCE cancer potency range in which they evaluated each of the underlying studies with respect to scientific validity and relevance for risk assessment. Based on their analysis, they identified liver tumors and the epidemiological study of Anttila et al. (1995) as the most reliable and scientifically valid basis for assessing TCE carcinogenicity. Reliance on the liver tumor endpoint was also suggested by the USEPA Science Advisory Board (USEPA, 2002b). In the USEPA's TCE cancer potency range, the Anttila et al. liver tumor data is associated with an oral slope factor of $7\text{x}10^{-2}$ $(\text{mg/kg-day})^{-1}$ and an inhalation unit risk of $9\text{x}10^{-7}$ $(\text{ug/m}^3)^{-1}$. These values are 6-fold and 120-fold lower, respectively, than the values used in the MSGRP HHRA. Because the Anttila et al. values represent a more scientifically defensible starting point for characterizing TCE's carcinogenic potency, the MSGRP HHRA overstates the risks from ingestion of TCE in groundwater and inhalation of TCE in indoor air, notwithstanding that neither of these exposure pathways should be identified as complete within the study area. For this reason, the MSGRP HHRA should be revised using the Anttila et al. values for TCE toxicity if these pathways are not identified as incomplete.

Benzene Toxicity

- Using the most conservative toxicity value for benzene overstated the risks from exposure to benzene. True cancer risk from exposure to benzene cannot be ascertained, even though dose-response data are

used in the quantitative cancer risk analysis, because of uncertainties in the low-dose exposure scenarios and lack of clear understanding of the mode of action. For these reasons, a range of inhalation cancer slope factors for benzene (2.2E-06 ug/m3^{-1} to 7.8E-06 ug/m3^{-1}) and a range of oral cancer slope factors for benzene (1.5E-02 mg/kg-day^{-1} to 5.5E-02 mg/kg-day^{-1}) should be used in the MSGRP HHRA calculations.

1.1 USEPA's Exposure Assumptions are Overly Conservative

The Draft Baseline Human Health Risk Assessment Report for the Multiple Source Groundwater Response Plan (MSGRP) Northern Study Area (MSGRP HHRA) (USEPA, 2005a) was issued by USEPA on June 30, 2005, with comments due to the Agency on August 31, 2005. The MSGRP HHRA used very conservative, and in most cases overly conservative, assumptions to calculate potential human health risk for surface soils, subsurface soils, sediments, surface water, and groundwater. The results indicated that **no** risks or hazards are posed by the environmental media above regulatory guidelines under the current exposure scenarios, where the receptors evaluated include:

- **Current recreational teenager in the Halls Brook Holding Area (HBHA) wetland system;**
- **Current recreational adults and children consuming recreationally caught fish;**
- **Current day care child (within a specific area – note, there is currently no day care facility within the study area);**
- **Current indoor worker (vapor intrusion); and**
- **Current groundskeeper.**

In addition, **no** risks or hazards above regulatory guidelines were identified for the following future use scenarios:

- **Future recreational teenager in the HBHA wetland system, under both baseflow and storm event conditions;**
- **Future groundskeeper;**
- **Future construction worker exposure to surface soils;**
- **Future use of groundwater as industrial process water in the Class A property area; and**
- **Future use of groundwater in a warm water car wash in the Class A property area.**

Of special note is the fact that surface water and accessible surface sediments in the study area did not pose a risk above regulatory guidelines under any scenario.

In keeping with the tiered approach to risk assessment discussed below, because the very conservative assumptions used for these scenarios did not result in risk exceedances, these scenarios do not require further evaluation or comment.

Risks in excess of regulatory guidelines were calculated for the following hypothetical future use scenarios:

- **Future day care child based on exposure to surface and subsurface soils,**
- **Future construction worker based on exposure to subsurface soils and shallow groundwater,**
- **Future industrial worker using groundwater as process water in an open industrial system,**
- **Future car wash worker using groundwater in a hot water car wash facility, and**
- **Future dredger of sediments in the HBHA.**

USEPA guidance for risk characterization (USEPA, 1995a) explicitly states that the "core values of

transparency, **clarity**, **consistency**, and **reasonableness**" need to be used to guide agency risk assessments and risk characterizations. Moreover, the guidance states that USEPA needs to ensure that their *core assumptions fall within a "zone of reasonableness."* As *then-administrator Carol Browner* states, "While I believe that the American public expects us to err on the side of protection in the face of scientific uncertainty, I do not want our assessments to be unrealistically conservative. We cannot lead the fight for environmental protection...unless we use common sense in all we do" (USEPA 1995a).

These points are very important, particularly when viewed within the context of the MSGRP HHRA, where overly conservative assumptions about exposure and toxicity were used to develop unrealistic hypothetical future use risk estimates, and these risk results were used directly in the Feasibility Study (FS) (USEPA, 2005b) as the basis for preliminary remediation goal (PRG) development and alternatives development for the Proposed Plan (USEPA, 2005c).

1.2 A Tiered Approach to Risk Assessment was not Used

Many federal and state agency programs use a tiered approach to risk assessment. The basis of the tiered approach is that conservative assumptions are employed in the initial tier of the evaluation, and the results are used at the decision point to determine if no action is appropriate, and if not, whether remediation should be pursued, or whether the analysis would benefit from a more detailed or site-specific evaluation in a subsequent tier. All tiers are protective of human health, however, the non-site-specific values utilized in the initial tier are generally based on conservative, "default" exposure factors and reflect the conservatism and uncertainty in the default assessment process. Each successive tier uses increasingly more site-specific information, thereby reducing uncertainty. As described by USEPA, "In a tiered approach, one begins with a fairly simple screening level model and progresses to a more sophisticated and realistic (and usually more complex) models only as warranted by the finding and value added to the decision" (USEPA, 1997a).

Because of the great weight of decision making put on the MSGRP HHRA results as presented, USEPA should not have stopped the risk assessment process at this point. Rather, USEPA should have continued by carefully evaluating the assumptions made in the risk-driving scenarios, and the toxicity and environmental distribution of the risk-driving constituents, and developed more reasonable approaches to evaluating the scenarios and constituents. Both the risk findings and the value that would be added to the decision warrant the further evaluation.

USEPA guidance for risk characterization (USEPA, 1995b) states that strengths and limitations, including uncertainties, need to be clearly identified in the risk assessment. While an uncertainty section was provided in the MSGRP HHRA, it was cursory in nature. The guidance states "Identify those scientific uncertainties that if reduced (e.g., about whether or not we know if the agent causes cancer, about whether or not we know what happens at low doses, that we know the exposure only occurs in certain specific locations) or the policy choices and management decisions that if changed would make a real impact on the risk assessment" (USEPA, 2002a). This would specifically address the **reasonableness** criterion in the USEPA's risk characterization policy.

The comments provided below focus on the constituents and scenarios that are the risk-drivers in the MSGRP HHRA, and provide suggestions for how more reasonable, and yet still health protective, scenarios and assumptions should be used in a further tier of evaluation. Only after this further tier of evaluation is conducted should remedial decisions be made.

1.3 Reasonable Maximum Exposure Based on Upper Bound Estimates Overpredicts Risk

USEPA has stated that their goal is to develop an estimate of the reasonable maximum (upper-bound) exposure "that is reasonably expected to occur" for the receptors evaluated in the MSGRP HHRA (USEPA, 2005a). Most of the assumptions about exposure and toxicity used in this evaluation are representative of statistical upper-bounds or even maxima for each parameter. However, the end result of combining several such upper-bound assumptions is that the final estimate of potential exposure or potential risk is extremely conservative, and exceeds the criterion of a reasonable maximum exposure estimate.

This is best illustrated by a simple example. Assume that potential risk depends upon three variables (soil consumption rate, constituent concentration in soil and cancer slope factor (CSF)). The mean, 95% upper bound and maximum are available for each variable. One way to generate a conservative estimate of potential risk is to multiply the 95% upper bounds of the three parameters in this example. Doing so assumes that the 5% of the people who are most sensitive to the potential carcinogenic effects of a constituent will also ingest soil at a rate that exceeds the rate for 95% of the population, and that all the soil these people ingest will have a compound concentration that exceeds the concentration in 95% of the soil on site. The consequence of these assumptions is that the estimated potential risk is representative of 0.0125% of the population (0.05 x 0.05 x 0.05 = 0.000125 x 100 = 0.0125%). Put another way, these assumptions overestimate risks for 9,999 out 10,000 people, or 99.99% of the population, and the majority of people will have a much lower level of potential risk. Thus, it produces estimates of potential risk two to three orders of magnitude greater than the risk experienced by the average member of the potentially exposed populations. Even if a single 95% upper bound assumption (for example, the CSF) is combined with average (50^{th} percentile) assumptions for soil concentration and soil ingestion rate, the resulting estimates of potential risk still over predicts risk for 99% of the potentially exposed population (0.05 x 0.5 x 0.5 = 0.0125 x 100 = 1.25%). Even the combination of an upper bound estimate with just one average estimate results in the protection of 97.5% of a population (0.05 x 0.5 = 0.025 x 100 = 2.5%). This very conservative nature of the potential risks estimated by the risk evaluation process is not generally recognized.

Therefore, the use of multiple upper bound assumptions, as has been done in the MSGRP HHRA, substantially overestimates the "average" level and even the reasonable maximum level of potential risk. Having used the 95% upper bound (or sometimes the maximum) environmental medium concentration as the exposure point concentration (EPC) for all of the risk calculations and having used the USEPA-derived toxicity values, which are all upper-bound conservative values, means that all the risk results, regardless of whether the other exposure parameters are averages or upper bounds, will result in exceeding the level of protectiveness sought under USEPA guidance. Therefore, it is reasonable that the exposure parameters used to define the scenarios be based on reasonable and average estimates, not upper bounds. Specific examples of the unnecessary over-conservatism in exposure and toxicity values in the MSGRP HHRA are provided in the discussions below.

1.4 Groundwater Exposure Scenarios

The Massachusetts Department of Environmental Protection's (MADEP) Groundwater Use and Value Determination for the Site and study area supports a low use and value of the groundwater (see Appendix 6M of the MSGRP HHRA). In addition, the MADEP has also provided a classification of the groundwater as a Non-Potential Drinking Water Source Area.

Based on a discussion with Mr. John Fralick, a Health Agent of the Woburn Health Department, special permits are required for well installation within the City of Woburn. The following were provided by Mr. Fralick:

- **Wells and the use of city water are mutually exclusive;**
- **Special permits are required for well installation; and**
- **Wells should not be installed on hazardous waste sites; there are approximately 250 hazardous waste sites in Woburn.**

Based on this information, it is entirely unlikely and unreasonable to assume that well water would be used for any purpose with in the Industri-Plex Site and the MSGRP study area. Therefore, the future groundwater use scenarios (industrial worker process water use and car wash worker) should not be included in the MSGRP HHRA as exposure to groundwater used for industrial or commercial purposes is not a complete exposure pathway.

By reasonably assuming that use of groundwater as industrial process water or as car wash water will not occur in the future, no risks or hazards would be calculated for these scenarios. The only reasonable groundwater exposure scenarios are the potential for vapor intrusion from the subsurface into overlying buildings, and the potential contact by a construction worker with shallow groundwater in an excavation trench.

Vapor intrusion from the subsurface (groundwater or soils) to indoor air, has been directly evaluated by the collection of soil gas samples in the area of the highest volatile organic compound (VOC) concentrations in groundwater. The soil gas data were used to predict maximum indoor air concentrations of VOCs, which were compared to Region 9 preliminary remediation goals (PRGs) for ambient air (a conservative screen for this industrial/commercial area as a 24-hour per day exposure is assumed). All of the concentrations were below the PRGs, and the scenario was not further evaluated in the MSGRP HHRA.

To further illustrate the overly conservative exposure assumptions, the groundwater receptors evaluated by USEPA (future car wash worker, future industrial worker, and future construction worker) are discussed below.

1.4.1 Future Car Wash Worker Groundwater Exposure Scenario

Based on existing administrative controls, a car wash scenario using groundwater should not be included in the MSGRP HHRA. Nonetheless, there are specific issues with the scenario as constructed by USEPA that need to be discussed. The zoning map and supporting information for the City of Woburn (City of Woburn, 2004) indicate that the area encompassed by the Industri-Plex Site and the MSGRP study area are zoned B-I (Business Industrial), I-P (Industrial Park), I-P2 (Industrial Park) and OS (Open Space). Use of a property as a car wash is prohibited in areas zoned I-P, I-P2, and OS (City of Woburn, 2005). Only two small areas are zoned B-I, and for this zoning designation, possible use as a car wash requires a special permit. The two B-I areas are (as shown on the attached zoning map):

- **B-I #1: The area bounded by the southern-most portion of the HBHA to the west, Mishawum Rd. to the south, and Commerce Way to the east, and extending north of Mishawum Rd. approximately 1000 feet (this is basically the area covered by the Woburn Mall); and**
- **B-I #2: The area bounded to the east by Interstate 93, bounded to the north by the Regional Transportation Center (RTC) exit/entrance to Interstate 93, extending approximately 700 feet south on Commerce Way, and from there, east to the terminus of Commonwealth Ave. The B-I designation also includes the area between Interstate 93 and Commonwealth Ave (approximately 700 feet south along Commonwealth Ave.) that encompasses Phillips Pond.**

Therefore, there are only two locations within the Industri-Plex Site and the MSGRP study area where car washes could be located, and only by special permit. B-I #2 is within the area identified in the MSGRP HHRA as Class A property (the Class A wells located within B-I #2 are CA-07, B5-05, CA-08, B5-04 and CA-09 – see Figure 5 of the MSGRP HHRA; USEPA, 2005a). The risk assessment concluded that the Class A property wells did not pose a risk in exceedance of regulatory guidelines for any groundwater use scenario, including a car wash. Four wells are located within the B-I #1 area (L2-02, L2-03, L2-04, and L205). However, no risk exceedances were attributed to these four wells (see Figure 2-2 of the FS). Review of the data provided for these wells (Appendix 4B-1 of the MSGRP Remedial Investigation (RI) Report; USEPA, 2005d) indicate that for the constituents identified as risk drivers for this scenario (1,2-dichloroethane, benzene, trichloroethylene, and naphthalene), all four wells were non-detect for benzene, and the other constituents were not analyzed. [Note, there are additional data presented in the RI Report appendix for locations L2-03 and L2-05 that were not used in the risk assessment. The data were non-detect for all four risk-drivers.] Therefore, no risks or hazards would be identified for a car wash worker in the only two plausible use areas based on zoning.

There are also the following specific issues with the car wash/shower model:

- **The exposure duration used for the car wash worker (25 years) is likely too high, based on USEPA occupational tenure estimates. A more reasonable value is 9 years, which is based on the median occupational tenure for all workers aged 35-39 years (USEPA, 1997b)**
- **Under the USEPA exposure scenario, the car wash worker is exposed to the modeled air concentration for 8 hours/day. However, this is likely an overestimate of the amount of time that the worker is exposed to the modeled air concentration, since it is likely that the worker does not stand in the direct spray area. A value of 4 hours is more reasonable, as it is unlikely that cars are transiting the car wash on a constant basis.**
- **The air modeling using the "shower model" was done with model inputs for a residential bathroom, which are not appropriate for a car wash. This flaw resulted in inhalation risks that are too high as well as PRGs for groundwater that are too low.**
- **The MSGRP HHRA used a "shower volume" of 6 m^3 in its calculation for the car wash scenario. A more realistic estimate of the volume of a car wash is 1000 m^3, based on an estimated car wash size of 90 x 20 x 15 feet = 27,000 ft^3 or 1000 m^3.**
- **Per the following website:**

  http://seattletimes.nwsource.com/html/makeitcount/2002410023_ecoconsumer31.html, it should be assumed that 45 gallons of water is used per car, and that the car wash trip takes one minute. The estimate of 45 gallons is the upper-bound for an automatic car wash. A duration of a 1 minute car wash is assumed. This equates to a water flow rate of 170 L/min.
- **Commercially available automatic car wash driers can be found on the following website: http://www.sonnysdirect.com/system_models_detail_660.html. The apparatus shown has 4 blowers working at 4000 ft^3 per minute (conservatively assuming 10 HP motors). Assuming this occurs within the 27,000 ft^3 car wash, the air exchange rate in the car wash would be 0.6 min^{-1} (4 x 4000 ft^3/min ÷ 27,000 ft^3).**

The effect of applying these more realistic exposure parameters to the car wash "shower model" is to decrease the predicted air concentrations up to two orders of magnitude.

Conclusion - The use of groundwater in a car wash scenario should not have been included in the risk assessment as a complete exposure pathway based on City of Woburn zoning and groundwater use restrictions. However, even if it was included, it should only have been applied to the B-I zoning areas, and only using data from wells located in these areas, not using the summarized data for the Site and study area as a whole. If this had been done, risks for this receptor would be zero in the B-I #1 area (as no constituents were detected) and would not have exceeded the regulatory guidelines in the B-I #2 area. Moreover, if the shower model had been correctly applied to the data, whether in the B-I areas or erroneously for site-wide groundwater, it is likely that no regulatory guidelines would have been exceeded.

1.4.2 Future Industrial Worker Groundwater Exposure Scenario

The hypothetical future industrial worker is assumed to contact groundwater used as industrial process water in an open system via ingestion, dermal, and inhalation exposure pathways. First, as indicated above, it is not reasonable to assume that groundwater would be used in this manner in the future, therefore, these pathways should not be identified as complete in the risk assessment.

Although an industrial groundwater use scenario should not be included in the MSGRP HHRA, there are specific issues with the scenario as constructed by USEPA that need to be discussed. It is assumed that the industrial worker would ingest the process water at a rate of 50 ml per day (slightly less than a quarter cup of water per day). This is the same high intensity water ingestion rate that is assumed for a swimming scenario, where someone is completely submerged in water. This assumption is not reasonable, and is not consistent with USEPA's assumption concerning water ingestion for the recreational teenager in the MSGRP HHRA. For that scenario, USEPA assumed that ingestion of surface water while wading was an incomplete exposure pathway, stating "Ingestion of surface water is not quantitatively evaluated for wading since it is unlikely that teenagers would ingest more than a negligible amount of surface water" (USEPA, 2005a). It is also a reasonable expectation that industrial workers would not ingest more than a negligible amount of process water during the course of a work day, especially considering the health and safety training a worker would receive on the job. Moreover, in its dermal pathway evaluation for this receptor, USEPA assumed dermal contact with process water for one hour each day, and it is presumably during this hour that the water ingestion would occur. If USEPA is assuming contact with water only one hour during the day, then water ingestion would only occur during that hour, which means that this 1/4 cup of water would be ingested in that short time rather than in tiny incidental sips throughout the day. This is not a reasonable expectation. Therefore, under a hypothetical future industrial worker scenario, the water ingestion pathway should be identified as incomplete.

Conclusion - As the future use of groundwater as industrial process water should be identified as an incomplete pathway, no risks or hazards would be calculated for this scenario. If the scenario is unreasonably included in the MSGRP HHRA, the water ingestion pathway should be designated as incomplete.

1.4.3 Future Construction Worker Groundwater Exposure

USEPA also assumed that the construction worker would ingest shallow groundwater encountered in an excavation trench at a rate of 50 ml per day (slightly less than a quarter cup of water per day). Again, this is the same high intensity water ingestion rate that is assumed for a swimming scenario, where someone is completely submerged in water. This assumption is not reasonable, and is not consistent with USEPA's assumption concerning water ingestion for the recreational teenager in the MSGRP HHRA. For that scenario, USEPA assumed that ingestion of surface water while wading was an incomplete exposure pathway, stating "Ingestion of surface water is not quantitatively evaluated for wading since it is unlikely that teenagers would ingest more than a negligible amount of surface water" (USEPA, 2005a). It is also a reasonable expectation that construction workers would not ingest more than a negligible amount of process water during the course of a work day, especially considering the health and safety training a worker would receive on the job. Moreover, in its dermal pathway evaluation for this receptor, USEPA assumed dermal contact with water in an excavation for one hour each and every construction day, and it is presumably during this hour that the water ingestion would occur. Therefore, under a future construction worker scenario, the water ingestion pathway should be identified as incomplete.

Conclusion - As ingestion of shallow groundwater during excavation activities should not be identified as a complete exposure pathway, no risks or hazards would be calculated for this pathway. Dermal contact with groundwater during excavation did not result in risks above regulatory guidelines.

1.5 Soil Exposure Scenarios

1.5.1 Arsenic Bioavailability

The critical soil exposure scenarios that have served as the basis for the FS and the Proposed Plan recommendations for the study area (USEPA, 2005a) are the construction worker and the day care child scenarios. Arsenic is the major risk driver for both of these scenarios. Arsenic is also a major risk driver for the sediment exposure scenarios assumed for the reaches of the Aberjona River south of Route 128. To address one aspect of the uncertainty in those risk estimates, USEPA conducted an in vivo study to develop a relative bioavailability (RBA) for arsenic in sediments in this area (provided as Appendix 6K of USEPA, 2005a). The RBA chosen for use was the highest, i.e., most conservative, of the mean values calculated from the study results (51%). This RBA appropriately was also used to evaluate potential exposure to sediments in the study area.

As arsenic in soils is also an important risk-driver in the study area north of Route 128, USEPA should have conducted a bioavailability study of the soils in this area. In the absence of a bioavailability study for soils, USEPA should also have applied the RBA estimate to arsenic in soils in the study area as well as well as applying it to sediments. Although there may be some differences in soil chemistry between the two areas, the soils upon which USEPA has focused are the former Lake Mishawum bed sediments, and so reasonably could be expected to behave similarly. And as USEPA has used the highest, most conservative RBA, it would be much less likely that potential exposures would be underestimated using this value.

Conclusion - Use of the RBA for soils would result in an almost 2-fold decrease in risks calculated for ingestion of arsenic in soils pathway – ingestion of arsenic in soils is the risk-driver for both the construction worker and day care child scenarios.

1.5.2 Future Construction Worker Soil Exposure Scenario

The USEPA has used overly conservative exposure assumptions to evaluate the construction worker soil ingestion exposure pathway. While the soil ingestion rate used in the MSGRP HHRA, 200 mg/day, is lower than some agency default values, it is still not a realistic estimate. The MADEP recognizes the uncertainty and variability in soil ingestion estimates and states, "Rather than use a combination of assumptions and measured data that imply a high degree of scientific validity, DEP has chosen the simple, and transparent, assumption that an enhanced incidental soil ingestion rate [for a construction worker] is equal to approximately that of a child playing outdoors, 100 mg/day" (MADEP, 2002a).

It should be noted that additional support for a 100 mg/day rather than a 200 mg/day soil ingestion rate comes from a paper by Kissel and coworkers (Kissel et al., 1998) that presents the results of a study of the transfer of soil from hand to mouth by intentional licking. Incidental soil ingestion is assumed to occur due to the transfer of soil in hand to mouth events. Soil was loaded onto the skin by pressing the hand onto soil, and the amount transferred to the mouth was measured. The thumb sucking, finger mouthing, and palm licking activities resulted in geometric mean soil mass transfers of 7.4 to 16 mg per event. The author concludes that "transfer of 10 mg or more of soil from a hand to the oral cavity in one event is possible, but requires moderate soil loading and more than incidental hand-to-mouth contact." However, "the fraction of soil transferred from hand to mouth that is subsequently swallowed is unknown but may be less than 100 percent." In addition, "the adult volunteers in this study reported that the presence of roughly 10 mg of soil in the mouth is readily detected (and unpleasant). Repeated unintentional ingestion of that mass of soil by adults therefore seems unlikely," especially when 10 such events would be required to achieve a 100 mg/day soil ingestion rate.

In addition to the soil ingestion rate issue, USEPA has calculated risks and hazards for the construction worker for surface soil and subsurface soil separately. As excavation involves exposure to both soil horizons, the exposure point concentrations (EPCs) for this scenario should have been calculated using the combined surface soil and subsurface soil data sets, not evaluated as two separate data sets.

Conclusion - Use of the more realistic, yet upper-bound, soil ingestion rate of 100 mg/day for the construction worker would result in a 2-fold reduction in risk and hazard estimates for this pathway. Coupled with the use of the arsenic bioavailability factor for soil ingestion (resulting in an additional 2-fold reduction in ingestion risk and hazard estimates), and elimination of the shallow groundwater ingestion pathway, the resulting potentially carcinogenic risks would not exceed the regulatory guidelines for the construction worker, and the hazard index would be only slightly above the regulatory guideline of 1 for the SO (former Mishawum Lake and associated wetlands) subsurface soil exposure area, and would be below the regulatory guideline for the SO surface soil exposure area.

The ENSR-derived exposure parameters have been used to calculate PRGs for the construction worker scenario, and have been compared to the PRGs calculated by USEPA in the FS. The table below compares the PRGs, calculated with and without the use of the bioavailability factor, and the input exposure assumptions. As can be seen, use of more realistic yet still conservative exposure factors results in PRGs for arsenic in soil for the construction worker scenario that are higher than the USEPA-derived values. The 1000 mg/kg PRG for arsenic should be used, following the methods provided under the section "Application of the PRGs" below, to identify areas where there may be exceedances.

		PRG (mg/kg) for Construction Worker Scenario					
		USEPA Exposure Factors			ENSR Exposure Factors		
Compound		Based on Risk of $1x10^{-4}$	Based on HI = 1	Selected (a)	Based on Risk of $1x10^{-4}$	Based on HI = 1	Selected (a)
Arsenic	Unadjusted	4.34E+03	2.79E+02	**279**	7.96E+03	5.12E+02	**512**
Arsenic	Bioavailable	8.45E+03	5.49E+02	**549**	1.55E+04	1.01E+03	**1007**

Notes:

(a) Lower of PRGs calculated based on cancer and noncancer effects.

Construction Worker Scenario	USEPA Exposure Factors	ENSR Exposure Factors
Soil Ingestion Rate (mg soil/day)	200	100
Soil on Skin (mg/cm2)	0.20	0.20
Skin Exposed (cm2)	3300	3300
Body Weight (kg)	70	70
Exposure Frequency (days)	125	125
Exposure Duration (years)	1	1
Averaging Time (cancer) (days)	25550	25550
Averaging Time (noncancer) (years)	1	1

1.5.3 Day Care Child Soil Exposure Scenario

Although the study area is zoned B-I (Business Industrial), I-P (Industrial Park), I-P2 (Industrial Park) and OS (Open Space), day care centers are prohibited only within the Open Space areas. However, an

Activity and Use Limitation (AUL) has been established under the Massachusetts Contingency Plan (MCP) program for the property at 10 Commerce Way, permitting day care "inside the building" where the use does not result in direct exposure to subsurface soils. For the remainder of the properties, use as a day care center is allowed. The day care center that was operating within the study area has since closed (note that the MSGRP HHRA did not result in an exceedance of regulatory guidelines for the current day care child scenario based on soil data in the vicinity of the now-closed center).

Many of the exposure parameters used to evaluate the current and future day care child scenario are overly conservative, resulting in unrealistically high exposure and risk estimates for this receptor. The various exposure parameters are discussed below.

Exposure Duration - USEPA used an exposure duration of 6 years for the day care child, which is greater than a possible maximum value. Calls to the public school systems in the towns surrounding the study area (Woburn, Wakefield, Burlington, Wilmington, Reading, Winchester, Lexington, and Stoneham) indicated that children begin a full-day Kindergarten program at age 5. Pre-Kindergarten is also available for children at age 4. Therefore, a typical child may be in day care from infancy until age 5 or potentially only until age 4. Since not all children will go to Pre-Kindergarten, it is conservative to assume that a child may attend day care be between ages 0 and 5. However, children from 0 to 1 year will not be playing outdoors, therefore, a realistic upper-bound estimate of exposure duration for soil ingestion for a day care child is 4 years. Note, this does not take into account children entering pre-Kindergarten, and assumes that children will remain in a single day care center until they reach school age.

Body Weight - While the exposure duration should be changed to 4 years to encompass a 1 to 5 year old child that may be exposed to constituents in soil, rather than the 6 years for the 0 to 6 year old child used by USEPA, the average body weights for the two receptor populations stays the same at 15 kg, based on information in USEPA (1997b).

Exposure Frequency - USEPA used an exposure frequency for the day care child of 150 days per year that is also overly conservative. MADEP's default exposure frequency for a residential child's (0 to 6 years old) exposure to outdoor soil is 150 days/year, which equals 5 days/week from April to October (MADEP, 1995) when the soil is typically available for contact (i.e., ground is not frozen or covered by snow).

MADEP (2002b) states that the exposure frequency for a day care child is believed to be lower than that of a residential child, as day care children's activities do not represent high-end soil contact which would be experienced by the residential child, because day care children's activities include both inside and outside play. Therefore, the exposure frequency of 150 days/year would likely be an over-estimate of the exposure frequency for a day care child. One aspect controlling exposure to soil is the meteorological conditions in the area, as described below.

A meteorological factor is generally used to account for the fraction of the year during which exposure to constituents at the ground surface may occur (Sheehan et al., 1991; USEPA, 1989). It is reasonable to assume that direct contact with soil or soils or intrusive activities will not occur for day care children during inclement weather, i.e., when it is raining or snowing, when the ground is wet or frozen, or when snow or ice (32 degrees F) are covering the ground. Thus the frequency of contact with soils is adjusted for these location-specific meteorological conditions (USEPA, 1989).

There are only a few metrics that can be used to describe the fraction of the year when meteorological conditions are likely to limit exposure. These include temperature and the amount of precipitation per day and per year, which includes rain, snow, and ice. The National Climatic Data Center (NCDC) provides daily temperature and precipitation data (NCDC, 2004). It is assumed that exposure to soils is limited on days when the maximum temperature is less than 32 degrees F. The number of days with precipitation greater than 0.1 inches is selected as the best representation of when exposure is likely to be limited by snow, rain, or ice. The choice of a precipitation target of 0.1 inches is in keeping with guidance provided in the "Compilation of Air Pollution Emission Factors", which assumes that soil suspension will not occur on days with more than 0.01 inches of precipitation (USEPA, 1995c). It is probable, however, that this metric both over- and under-estimates the potential exposure in some conditions. For, example, it is possible that some exposure to soils may occur on days when it rains just over 0.1 inches in the early morning and then the ground dries during the course of the day. Alternatively, significant rainfall, such as greater than 1 inch, is likely to saturate the ground for consecutive days, and several inches of snow (which may fall all on one day with one storm) may cover the ground and inhibit direct contact for several days. With both of these considerations in mind, it is likely that a meteorological factor based on inclement days defined as precipitation greater than 0.1 inches and maximum temperatures less than 32 degrees F is reasonable. The use of the meteorological factor does not imply that no soil exposure occurs on these days, only that exposure during those periods is negligible.

Based on ten years of meteorological data (1994-2003) for Boston, Massachusetts, National Weather Service (NWS) station at Logan International Airport, a site-specific meteorological factor was derived (NCDC, 2004). This station provides the best data capture in the area for both hourly temperature and hourly precipitation data. The difference in weather conditions from Boston to Woburn is not expected to be significant. On the average, 72.8 days/year in this area receive 0.1 or greater inches of precipitation, and there are typically 23.7 days/year with a maximum temperature of 32 degrees F or below (i.e., the temperature never rises above freezing during the day) (NCDC, 2004). Accounting for days when both events occur (2.6 days), the number of inclement days, 93.9, can be calculated (72.8 + 23.7 – 2.6 = 93.9). It is assumed that these days are evenly spaced throughout the course of the year. The meteorological factor is then calculated (93.9/365 = 25.7%). Thus it is assumed that exposure to soils will not occur for the day care child 25.7% of the assumed days of exposure (exposure frequency) due to weather restrictions. Applying this factor to the MADEP residential exposure frequency of 150 days per year results in an exposure frequency of 111.4 days/year or approximately 115 days/year for the day care child (where it is assumed that rain events between April and October limit soil contact).

Soil Ingestion Rate - The soil ingestion rate used in the MSGRP HHRA for the day care child is 200 mg/day, which is the default value for a residential child used by USEPA. This is an upper bound number that is not justified for the scenario. The MADEP's residential child soil ingestion rate is 100 mg/day (MADEP, 1995). As noted above, MADEP (2002b) states day care children's activities do not represent high-end soil contact which would be experienced by the residential child, because day care children's activities include both inside and outside play. Thus it would be reasonable to assume that the day care child's soil ingestion rate would be even lower than 100 mg/day, however, it certainly represents a conservative upper bound for this receptor. This is also the average soil ingestion rate for residential children provided in USEPA's Exposure Factors Handbook (USEPA, 1997b). The soil ingestion rate of 100 mg/day should be used in the MSGRP HHRA for the day care child.

Surface Area and Soil Adherence Factor - A body surface area and soil adherence factor were recalculated for a day care child, assuming a 1 to 5 year old day care child can go outdoors and potentially contact soils. Using information provided in USEPA's Exposure Factors Handbook (USEPA, 1997b), as shown in the following table, a surface area of 2040 cm^2 was calculated based on the average (50^{th} percentile) surface area for males and females, including hands, forearms, lower legs, and feet. A soil adherence factor of 0.04 mg/cm^2 was calculated based on this revised surface area. The surface area of 2040 cm^2 and the soil adherence factor of 0.04 mg/cm^2 should be used in the MSGRP HHRA for the day care child.

	Day Care Child (1 to 5 years old)		
Exposed Body Part	**Surface Area 50th percentile (a) (cm^2)**	**Soil Loading Day Care Kids (mg/cm^2) (b)**	**Total Soil Mass (mg)**
Hands	364	0.0923	33.56
Forearms	425	0.0230	9.78
Lower legs	806	0.0195	15.72
Feet	445	0.0646	28.75
Total	2.040	--	87.80
Area-Weighted Soil Adherence factor (mg/cm2) = Soil mass/Surface area =			0.04

Note (a) - Data from USEPA (1997b). Based on average of boys (Table 6-6) and girls (Table 6-7) total body surface area (6.557 cm2), and mean percentages of total surface area for individual body parts (Table 6-8). Represents average 50th percentile surface area for males and females of hands. forearms, lower legs, and feet).

Note (b) - Data from USEPA (1997b). Table 6-12. Day care kids Nos. #1a, #1b ,#2c, #3.

Exposure Point Concentrations - Exposure point concentrations used in the MSGRP HHRA for the day care child soil exposure pathways are the 95% upper confidence limit (UCL) on the arithmetic mean. Implicit in this assumption is that soils with the highest constituent concentrations are exposed in areas in which day care children may be playing. In USEPA's guidance on lead (USEPA, 2001a, 2003a), standards are provided to be protective of children in residential areas. A value of 400 mg/kg is used for specific "play areas," while a value of 1,200 mg/kg is used to evaluate other areas of "bare soil" in residential yards. USEPA is acknowledging a distinction here between exposure areas, even within a residential yard. Assuming that the 95% UCL concentration will occur precisely within a child's play area is unrealistic. It is even more unrealistic to assume that all of the subsurface soil in the study are could one day be brought to the surface and be available for contact. It should be noted that the majority of the property in the study area has already been developed, i.e., subjected to construction and the reworking of soils, and it is still the subsurface soils that have the higher concentrations (EPC = 92 mg/kg in surface soils and 1900 mg/kg in subsurface soils). However, if the assumption of soil redistribution were correct, one would expect little or no difference in surface and subsurface soil concentrations in the study area as a result of the development. This assumption of subsurface to surface soil redistribution resulted in highly exaggerated risk estimates for the day care child.

Conclusion - For the future day care child assumed to be exposed to surface soils in the SO area, arsenic in soils is the risk driver, and application of the more realistic and reasonable exposure parameters described above would result in a hazard index that is below regulatory guidelines (the potential carcinogenic risk level is already below regulatory guidelines, but there would also be a decrease). Both would decrease with the application of the bioavailability factor.

Similarly, for the future day care child assumed to be exposed to subsurface soils in the SO area, application of both the more realistic and reasonable exposure parameters described above and the bioavailability factor would result in reductions in the hazard index and potential carcinogenic risk estimates, however, both would likely be above regulatory guidelines. However, the risk assessment results do not represent the extent to which the day care child exposure to subsurface soils scenario is unlikely to occur.

The ENSR-derived exposure parameters have been used to calculate PRGs for the day care child scenario, and have been compared to the PRGs calculated by USEPA in the FS. The table below compares the PRGs, calculated with and without the use of the bioavailability factor, and the input exposure assumptions. As can be seen, use of more realistic, yet still conservative exposure factors results in PRGs for arsenic in soil for the day care child scenario that are higher than the USEPA-derived values. The 274 mg/kg PRG for arsenic should be used, following the methods provided under the section "Application of the PRGs" below, to identify areas where there may be exceedances.

		PRG (mg/kg) for Day Care Child Scenario					
		USEPA Exposure Factors			ENSR Exposure Factors		
Compound		Based on Risk of 1×10^{-4}	Based on HI = 1	Selected (a)	Based on Risk of 1×10^{-4}	Based on HI = 1	Selected (a)
Arsenic	Unadjusted	1.31E+02	5.05E+01	**51**	5.42E+02	1.39E+02	**139**
Arsenic	Bioavailable	2.55E+02	9.93E+01	**99**	1.06E+03	2.74E+02	**274**

Notes:
(a) Lower of PRGs calculated based on cancer and noncancer effects.

Day Care Child Scenario	USEPA Exposure Factors	ENSR Exposure Factors
Soil Ingestion Rate (mg soil/day)	200	100
Soil on Skin (mg/cm2)	0.20	0.04
Skin Exposed (cm2)	2800	2040
Body Weight (kg)	15	15
Exposure Frequency(days)	150	115
Exposure Duration (years)	6	4
Averaging Time (cancer) (days)	25550	25550
Averaging Time (noncancer) (years)	6	4

1.6 Sediment Exposure Scenarios

1.6.1 Future Dredger Sediment Exposure Scenario

The future dredger scenario is the risk driver for the sediments in the HBHA. For the same reasons as discussed above for the future construction worker receptor, the soil/sediment ingestion rate for the dredger should be 100 mg/day in the MSGRP HHRA. This is a reasonable and yet still upper-bound estimate. It is unreasonable to assume that dredging activities would occur over a 2-year period. As with the construction worker, the exposure duration should be only 1 year in the MSGRP HHRA, which is both realistic and reasonable. The exposure frequency for this receptor in the MSGRP HHRA should also be the same as that for the future construction worker, 125 days per year, equivalent to 5 days per week for 25 weeks.

The EPCs used for this scenario are unreasonable, unrealistic, and do not reflect the scenario being evaluated. EPCs have been derived separately for each of the four sediment core locations in the HBHA. The arsenic concentrations, which are the risk drivers for this scenario, are highly variable, and with only 4 sample results for each location, the maximum detected concentration was used as the EPC. For example, at SC01, the arsenic concentrations are 150, mg/kg, 23 mg/kg, not detected and not detected. Using USEPA's methodology, the EPC for this location is 150 mg/kg. USEPA acknowledges this problem in the uncertainty section of the text, but that is not enough. Having been alerted to this problem, it should have been addressed appropriately. The maximum detected concentration was used as the EPC at all four locations. This use of the data, in conjunction with USEPA's exposure assumptions, assumes that the dredger works at a single location for a 2-year period and ingests the maximum detected concentration of arsenic at each location at a very high sediment ingestion rate. This is not at all realistic. There is a wealth of sediment information from the HBHA, and it is unrealistic to assume that dredging operations would occur only in these four locations. USEPA should carefully review the sediment data and use all of the data from locations that would cover hypothetical future dredging operations. It is unclear whether dredging operations would be incompatible with the remedies considered in the Proposed Plan (USEPA, 2005c).

Conclusion - It is likely that if the more realistic exposure assumptions and EPCs are used in the MSGRP HHRA, risks for this hypothetical future dredger receptor would not exceed regulatory guidelines.

1.7 Arsenic Toxicity

USEPA recognized some of the uncertainties in the cancer potency estimate for arsenic in the uncertainty section, but did not then review the risk assessment results and determine whether the uncertainties in the potency estimate could be addressed quantitatively, or whether more realistic values for other parameters could be used to off-set this uncertainty (see the discussion of tiered approaches above). Moreover, the predicted noncancer hazard for arsenic is the primary driver for many of the regulatory guideline exceedances. Therefore, the bases of both the cancer and noncancer toxicity values for arsenic are reviewed below.

1.7.1 Noncancer Reference Dose

To evaluate the chronic health effects of arsenic, two reports of an epidemiology study of Taiwanese populations consuming arsenic in drinking water and other sources (Tseng et al., 1968; Tseng, 1977) have been used by USEPA's Office of Research and Development (ORD) to derive the chronic reference dose (RfD) for arsenic that is included in USEPA's Integrated Risk Information System (IRIS) database (USEPA, 2005e). The RfD was verified in 1990 and was last revised in 1993 (USEPA, 2005e).

USEPA identified a No Observed Adverse Effects Level (NOAEL) of 0.0008 mg/kg-day from the Tseng studies based on the observation of hyperpigmentation, keratosis and possible vascular problems in the study population. An uncertainty factor of 3 was applied to account for lack of information on whether reproductive toxicity is a critical effect, and to account for some uncertainty as to whether the NOAEL accounts for all sensitive individuals. The resulting RfD is 0.0003 mg/kg-day.

This analysis does not reflect the results of a recently published comprehensive epidemiological study indicating that malnutrition enhances susceptibility to arsenic-related health effects (Mitra et al., 2004). Moreover, the underlying analyses presented in IRIS do not reflect the substantial number of studies that have been conducted since the RfD was last revised and that call into question the validity of the exposure estimates in the Tseng study population (e.g., Brown and Chen, 1995) or provide additional information regarding the noncancer health effects of arsenic in other populations (e.g., Guha Mazumder et al., 1998).

As noted above, a number of scientists have questioned the validity of the exposure characterization in the Tseng study population. For example, Brown and Chen (1995) noted that arsenic concentrations in drinking water in 40% of the villages in the Tseng study were characterized by a single well sample and, in others, use of both shallow and deep artesian wells led to arsenic concentration data in groundwater with very high coefficients of variation. In a modeling exercise, they found that eliminating data from the seven villages with the most suspect groundwater well data led to a very different dose-response curve. Specifically, these analyses suggested that disease incidence increased above background levels only when arsenic concentrations in groundwater were greater than 0.1 mg/L.

To determine a lowest observed adverse effect level (LOAEL), the average arsenic concentration in well water for the designated low exposure group (i.e., wells with concentrations between 0 and 0.30 mg/L) was identified by USEPA. The low exposure group wells include four surface wells with reportedly very low arsenic concentrations. Averaging the arsenic concentrations in the low exposure wells resulted in an arsenic concentration for these wells of 0.17 mg/L. Because this average includes data from wells where the arsenic concentration is essentially zero, this value provides a conservative estimate of the LOAEL concentration (i.e., the effects observed in the low dose group are most likely due to wells with arsenic concentrations at the upper end of the range). This conservative bias is unavoidable, however, because of the way the exposure data were categorized in the Tseng reports.

Based on the control group described in Tseng (1968) USEPA identified a NOAEL of 0.009 mg/L, stating that the control group "shows no evidence of skin lesions and presumably blackfoot disease, although this latter point is not explicitly stated." However, as noted in Tseng (1977) "none of the residents of the endemic area who had consumed only surface water or water from shallow wells developed blackfoot disease. This appears to be because the shallow well water is almost free from arsenic (0.001-0.017

ppm)." The arithmetic mean concentration of 0.009 mg/L of the range of arsenic concentrations in these wells was identified as the NOAEL.

This approach is problematic for two reasons. First, the accuracy of this concentration range is questionable. For example, Tseng et al. (1968) noted that "The shallow wells were usually free from arsenic (0.001 ppm), though some had a considerably higher concentration (1.097 ppm). Second, the NOAEL represents the lower bound of the effects threshold. Including individuals with drinking water concentrations as low as 0.001 ppm in the NOAEL population is the equivalent of including untreated control animals in the low dose group in a toxicology study. While such an approach does identify a concentration without likely adverse effects, it is an extremely conservative estimate of that concentration.

Because of these limitations, the observed NOAEL reflected in the Tseng data should not be used as the sole basis for quantifying potential toxicity associated with long-term exposures. Instead, to better reflect available information, the conservative observed NOAEL should be used in conjunction with the LOAEL. For example, the LOAEL from the 1977 Tseng report (0.170 mg/L) can be divided by a factor of 10 to derive a predicted NOAEL value of 0.017 mg/L. Because individuals in the shallow well group were exposed to arsenic in drinking water at concentrations up to this value without evidencing any symptoms of blackfoot disease, a concentration of 0.017 mg/L can be viewed as a reasonable prediction of the NOAEL. This concentration is equivalent to 0.0015 mg/kg-day, assuming consumption of 4.5 liters of water per day and a 55 kg bodyweight, the standard factors used by USEPA in adjusting concentration values based on the Taiwanese studies.

In its calculations, USEPA also adjusts the observed LOAEL and NOAEL derived from the Tseng et al. (1968) study to account for the amount of inorganic arsenic ingested as food. USEPA estimates that the arsenic intake from consumption of sweet potatoes and rice was 0.002 mg/day (or 0.00004 mg/kg-day assuming a 55 kg bodyweight). Based on currently available data, this estimate appears to be too low. Yams and rice in the Blackfoot disease endemic regions in Taiwan have been reported to be particularly high in inorganic arsenic (Yost et al., 1994).

USEPA has previously used a value of 0.05 mg/day (0.0009 mg/kg-day) for the Taiwanese dietary intake of arsenic. A diet-adjusted predicted NOAEL of 0.0024 mg/kg-day would be obtained by combining the 0.05 mg/day dietary arsenic intake rate with the predicted NOAEL estimate of 0.0015 mg/kg-day described above.

It should also be noted that, since the IRIS RfD was last revised in 1993, several other epidemiology studies of arsenic non-cancer health effects have been published (as discussed in NRC, 1999, 2001), including one by Guha Mazumder and coworkers (1998). The Guha Mazumder study provides additional support for the higher NOAEL value (identified above) that can be derived from the Tseng reports. Guha

Mazumder et al. studied a population in West Bengal, India, which was also exposed to arsenic via drinking water. The exposure durations in this study ranged from years to decades. This study presents two advantages relative to the study by Tseng et al. First, a large number of children were included in the study population, i.e., approximately 8 percent of the studied population was under the age of 10 years old. Second, the population generally had poor nutritional health. Thus, the data from this study provide some indication of the possible health consequences for a sensitive population.

In addition, unlike the blackfoot disease studied by Tseng (which has been reported to be associated with other exposures, e.g., Lu, 1990), Guha Mazumder studied both keratosis and hyperpigmentation. These latter two effects may be earlier endpoints in arsenic toxicity. In the Guha Mazumder et al. study, the prevalence of both keratosis and hyperpigmentation was extremely low in the lowest dose group (< 50 mg/L). Thus, 0.050 mg/L can be considered a minimal effect LOAEL. Assuming 4.5 L/day of water consumption and a 55 kg body weight (similar to the population in Taiwan), the estimated daily arsenic dose is 0.004 mg/kg-day. Dividing by a factor of 3 for the minimal effect LOAEL-to-NOAEL extrapolation results in a NOAEL of 0.0014 mg/kg-day, a value that is similar to what was derived above using the LOAEL from the Tseng reports. As noted above, the Guha Mazumder et al. study population included a large number of children and likely included a large number of malnourished individuals. Additional evidence of the malnourishment of this population and the resulting enhanced susceptibility to arsenic-related health effects is provided in a recently published case-control epidemiological study of more than 500 individuals from West Bengal which broke new ground in examining the impact of dietary nutrient intake levels on arsenic-related health effects (Mitra et al., 2004). These observations suggest that additional uncertainty factors are not required.

Moreover, it should be noted that epidemiological studies of U.S. populations consuming drinking water containing arsenic concentrations equal to or greater than 0.050 mg/L have not indicated adverse health effects such as those reported in the Tseng studies. For example, Valentine et al. (1992) surveyed four U.S. communities with arsenic concentrations in drinking water that were equal to or greater than 0.100 mg/L. Based on comparisons of the study group, with a control population with arsenic concentrations in drinking water that were less than 0.001 mg/L, the researchers reported "No difference in health status for gastrointestinal, neurological, musculoskeletal, circulatory and skin disorders was found." The difference in sensitivity seen between the populations studied by Tseng and Guha Mazumder and those in the U.S. may result from the differences in nutritional status of these groups or genetic differences in responses to arsenic (Buchet and Lison, 2000). This comparison again demonstrates the conservativeness of using the Tseng data to characterize potential health risks associated with arsenic for a U.S. population.

Conclusion - Based on this review of the available scientific data (including numerous studies that have been published since the RfD was last revised), use of a diet-adjusted NOAEL of 0.0024 mg/kg-day (reflecting a NOAEL of 0.0015 mg/kg-day and a dietary intake of 0.0009 mg/kg-day) together with an MOE of 1 represents a conservative (i.e., health-protective) toxicity benchmark (RfD = 0.0024 mg/kg-day) for assessing potential non-cancer health risks associated with long-term exposures. This RfD is 8-fold higher that that developed by USEPA. Use of this value would result in an 8-fold decrease in the calculated hazards in the MSGRP and would result in an 8-fold increase in the noncancer-based PRGs.

1.7.2 Cancer Potency Estimates

Detailed comments on the cancer potency estimate for arsenic were submitted to USEPA as part of Gradient Corporation's comments on the "Baseline Human Health Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA, USEPA Region 1, March, 2003." These comments are included here by reference. An overview of the comments and their applicability to the MSGRP HHRA are provided below.

USEPA has developed an oral cancer potency estimate for arsenic, which is available on IRIS (USEPA, 2005e). The cancer potency estimate suffers from many of the same issues as discussed above for the noncancer RfD.

Epidemiological studies conducted in the U.S. have consistently shown a lack of association between arsenic exposure and cancer outcomes. Studies looking at bladder and lung cancer in a population in Utah, skin cancer in a population in Oregon, childhood cancers in Nevada, childhood cancers in the vicinity of the ASARCO Ruston copper smelter, and bladder cancer mortality in 133 U.S. counties all failed to show any significant association between the outcomes and exposure to arsenic. It should also be noted that the exposure levels evaluated in the U.S. populations are substantially lower than those of the Taiwanese population upon which the arsenic cancer potency is based. Therefore, the arsenic cancer potency estimate developed by USEPA based on the Taiwanese data likely results in an overestimate of arsenic-related cancer risk in the U.S.

In addition, the model that USEPA has used to develop the arsenic cancer potency estimate assumes that the dose-response relationship is linear at low doses. There is substantial mechanistic information to indicate that the arsenic dose-response relationship is not linear at low doses. All of arsenic's plausible mechanisms, including indirect genotoxicity, modulation of DNA methylation patterns and DNA repair, and ability to induce protective cellular mechanisms, are consistent with a nonlinear dose-response. In addition, although several studies conducted on populations outside of the US have shown increased risk of cancer, risks are only increased at relatively high doses of arsenic, indicating support for a nonlinear dose-response.

In the MSGRP HHRA, USEPA has estimated site-related lifetime daily average arsenic intakes up to 0.97 µg/kg-day for a future day care child assumed to be exposed to arsenic in subsurface soil, and up to 0.03

µg/kg-day for an adult construction worker assumed to be exposed to arsenic in subsurface soil. In contrast, estimated arsenic intakes as high as 5.7 µg/kg-day have been experienced by U.S. populations without evidence of increased cancer risks. Specifically, for the Utah study, which is among the largest and best-conducted of the epidemiological studies of US populations with elevated arsenic exposures, average intakes of arsenic in drinking water ranged from 0.26 to 2.7 µg/kg-day (based on average drinking water consumption of 1L/day). Over 1,200 members of the Millard County, Utah, cohort resided in the two communities with the highest intake level (average 2.5 µg/kg-day), many for their entire lifetimes. Despite these elevated intakes, no elevated death rates from bladder or lung cancers were observed for those who died through November 1996 (2,203 cohort members), and death rates were not elevated among the cohort members with the highest levels of drinking water arsenic. The observed bladder and cancer mortality risks in the Utah study are lower than the baseline health risks predicted for the general population of Utah, even with arsenic drinking water concentrations that on average were as high as 0.191 mg/L, and at times exceeded 0.6 mg/L.

In non-U.S. studies, populations were exposed to arsenic in drinking water at concentrations of 0.1 mg/L or greater. In order to calculate arsenic intakes, certain assumptions must be made about the exposed populations. For example, using estimates of water consumption patterns in Taiwanese males developed by the National Research Council (NRC, 1999; NRC, 2001), calculated arsenic intakes at 0.1 mg/L in drinking water are 8.2 µg/kg-day. This assumes an average Taiwanese male weighs 55 kg and drinks 4.5L/day of arsenic-containing water. If one assumes, based on re-analysis of the Taiwan data, that cancer is not increased until levels of 0.4 mg/L, then the estimated carcinogenic intake in Taiwan would be 22 µg/kg-day.

In contrast, site-related exposures are considerably less than the drinking water exposures in these studies. As noted above, the highest lifetime average daily intake calculated in the MSGRP HHRA of 0.3 ug/kg-day for the construction worker exposure to subsurface soil is 27 times lower than doses received at 0.1 mg/L in the Taiwanese studies. Thus, modest intakes of arsenic from exposure to surface or subsurface soil in the MSGRP HHRA study area are unlikely to present a significant toxicological concern.

Moreover, estimated arsenic exposures in the MSGRP HHRA are not significantly different than arsenic exposures permitted in drinking water at the MCL of 0.01 mg/L, which is a level designed to be health protective (USEPA, 2001d). For arsenic in subsurface soil, the future day care child intake is 0.97 ug/kg-day and the future construction worker intake is 0.3 ug/kg-day. By comparison, exposure to arsenic in drinking water at the current MCL of 0.01 mg/L would yield an estimated intake of 0.7 µg/kg-day for a 15 kg child and 0.3 µg/kg-day for a 70 kg adult, based on drinking water intakes of 1L/day for children and 2L/day for adults. Thus, the hypothetical and unlikely exposures to arsenic in subsurface soils at the site are essentially the same as those considered by USEPA to be health protective in drinking water. Note that the calculated site intake rates would be much lower using the recommended exposure parameters discussed in this document.

Conclusion - The uncertainties and high degree of conservatism in the cancer potency estimates provide an additional reason why the MSGRP HHRA should have been refined with more realistic exposure assumptions prior to using it as the basis for remedy decisions.

1.8 Trichloroethylene (TCE) Toxicity

TCE presents an inhalation risk for the car wash worker receptor. The USEPA's 2001 draft TCE reassessment presents not individual cancer potency values (as is the normal practice) but a range of values, with each value based on data from different animal or human studies (USEPA, 2001c). USEPA's PRGs for the MSGRP HHRA were calculated using cancer potency values from the upper ends of these ranges, i.e., $4x10^{-1}$ (mg/kg-day)$^{-1}$ as the oral slope factor and 1.1x 10^{-4} (ug/m^{3})$^{-1}$ as the inhalation unit risk. Note that there is no statistical basis for selecting values at the top of the range; they are not "upper bound" values in the traditional sense because each potency value is based on a different dataset and the likelihood of a particular potency value being "right" is independent of the others. This was also noted by the USEPA Science Advisory Board which recommended against treating the range as a statistical distribution (USEPA, 2002b). As noted below, an alternate oral slope factor and inhalation unit risk can be developed from USEPA's 2001 TCE analysis, in a manner consistent with USEPA recommendations.

Using the top value in the cancer potency range is problematic in that such an approach ignores questions about the scientific validity and relevance of the underlying studies. The cancer potency values used for the MSGRP HHRA are based on the ecological study of Cohn et al. (1994), which evaluated cancer risk in Northern New Jersey residents exposed to TCE and other chemicals in drinking water. Problems with this study include the estimation of exposures from community-wide drinking water data collected 10 to 20 years after the exposure period of interest, and the residents' simultaneous exposures to other chlorinated chemicals in drinking water. These are significant limitations in using the Cohn et al. data for risk assessment. As noted by USEPA, "The residents were exposed to other drinking water contaminants, so that attributing all risk to TCE [as was done in the USEPA analysis] can over estimate the risk from TCE." (USEPA, 2001, p. 4-17, comment in brackets added). Based on the potential problems with the Cohn et al. study, the cancer potency values that are derived from it should not be used in the MSGRP HHRA.

Lewandowski and Rhomberg (2005) recently published an analysis of the USEPA TCE cancer potency range in which they evaluated each of the underlying studies with respect to scientific validity and relevance for risk assessment. Based on their analysis, they identified liver tumors and the epidemiological study of Anttila et al. (1995) as the most reliable and scientifically valid basis for assessing TCE carcinogenicity. Reliance on the liver tumor endpoint was also suggested by the USEPA Science Advisory Board (USEPA, 2002b). In the USEPA's TCE cancer potency range, the Anttila et al. liver tumor data is associated with an oral slope factor of 7×10^{-2} $(mg/kg\text{-}day)^{-1}$ and an inhalation unit risk of 9×10^{-7} $(ug/m^3)^{-1}$. These values are 6-fold and 120-fold lower, respectively, than the values used in the MSGRP HHRA.

Conclusion - Because the Anttila et al. values represent a more scientifically defensible starting point for characterizing TCE's carcinogenic potency, the MSGRP HHRA overstates the risks from ingestion of TCE in groundwater and inhalation of TCE in indoor air, notwithstanding that neither of these exposure pathways should be identified as complete within the study area.

1.9 Benzene Toxicity

USEPA has classified benzene as a known human carcinogen (USEPA, 2005e) based on studies of the incidence of leukemias in workers exposed to benzene (between 2 ppm to over 200 ppm, or 6.5 mg/m^3 to over 650 mg/m^3) in the workplace. As noted by USEPA (2005e):

> **"At present, the true cancer risk from exposure to benzene cannot be ascertained, even though dose-response data are used in the quantitative cancer risk analysis, because of uncertainties in the low-dose exposure scenarios and lack of clear understanding of the mode of action. A range of estimates of risk is recommended, each having equal scientific plausibility."**

The range of inhalation cancer slope factors for benzene is 2.2E-06 $(ug/m3)^{-1}$ to 7.8E-06 $(ug/m3)^{-1}$. The range of oral cancer slope factors for benzene is 1.5E-02 $(mg/kg\text{-}day)^{-1}$ to 5.5E-02 $(mg/kg\text{-}day)^{-1}$. These ranges, not a single point value, should be used in the MSGRP HHRA calculations.

Conclusion - The result of using the most conservative toxicity value for benzene is to overstate the risks from exposure to benzene.

1.10 Site-Specific Preliminary Remediation Goals (PRGs)

1.10.1 Errors in the PRG Equations

It should be noted that the PRG equations provided in Appendix A of the FS (USEPA, 2005b), are incorrect on both the risk assessment and simple arithmetic levels. The use of the RAGS Part D (USEPA, 2001b) format for the MSGRP HHRA does not help with the transparency of the risk assessment process, nor do errors such as these.

For example, for the Industrial Worker PRGs, the PRG equations attempt to combine oral, dermal and inhalation exposures. The overall form of the equation is incorrect. The correct starting equation is:

EQN 1: PRG = Target Risk / [(SForal * ing intake factors) + (SFderm * derm intake factors) + (SFinh * inh intake factors)]

This does NOT equal:

EQN 2: PRG = [Target risk/(SForal * ing intake factors)] + [Target risk/(SFderm * derm intake factors)] + [Target risk/(SFinh * inh intake factors)]

1.10.2 Application of the PRGs

USEPA has used the site-specific PRGs calculated in the FS as screening levels to identify locations that have a PRG exceedance, and thus areas that require additional action. Use of PRGs in this manner exaggerates the areas that may need to be addressed in the FS. The PRGs are EPC surrogates, just as the EPCs take into account the distribution of the data and ideally represent the 95% upper bound on the arithmetic mean concentration, so too should the PRGs. To identify locations to be addressed by the FS, the following steps should be taken:

- Sample results within an exposure area should be ranked according to concentration.
- If no results exceed the PRG, no further action is needed.
- If there are PRG exceedances, the location of the maximum detected concentration should be identified and the result removed from the dataset.
- The EPC should be recalculated without this last value, and compared to the PRG.
- If the EPC is less than the PRG, no further calculation is needed and the remedy should address the location of the exceedance.
- If the EPC is greater than the PRG, steps 3 and 4 should be repeated until the EPC is less than or equal to the PRG.
- The remedy should then address the locations that have been eliminated from the EPC calculation using this process.

A similar process should be used when evaluating confirmatory sampling. Data from samples from areas excavated or otherwise sequestered should be removed from the EPC calculations, and the results of confirmatory samples should be added. The remedy can be concluded once the recalculated EPC is less than or equal to the PRG.

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Technical Specialties

- Mechanisms of Carcinogenesis and Mutagenesis
- Risk Assessment

Professional History

- ENSR Consulting and Engineering
- Massachusetts Institute of Technology
- University of Idaho

Education

- PhD (Toxicology) Massachusetts Institute of Technology, 1991
- BS (Zoology) University of Idaho, 1983
- BS (Chemistry) University of Idaho, 1983

Professional Registrations and Affiliations

- Diplomate, American Board of Toxicology, 1994
- Society of Toxicology
- Society for Risk Analysis
- Phi Beta Kappa
- Regulatory Toxicology and Pharmacology

Representative Project Experience

A. Representative Superfund Experience

Pines Area of Investigation, Indiana.. Serving as project manager for the Remedial Investigation/Feasibility Study for the Respondents of an Administrative Order on Consent (AOC) being administered as a Superfund-like site under the USEPA Region 5 Superfund program. The AOC addresses the placement of coal combustion by-products (CCBs) within a local permitted landfill and allegedly used as fill in other locations within the Area of investigation. Activities to date include agency negotiations on the AOC and scope of work; submittal and subsequent approval of a Site Management Strategy document, the RI/FS Work Plan (including a Field Sampling Plan, Human Health and Ecological Risk Assessment Work Plans, HASP, QAPP, and a Quality Management Plan), and additional Sampling and Analysis Plans; and communications activities (including a website and regular mailings of information updates to the community).

Delaware Sand & Gravel Remedial Trust, Delaware. Providing risk assessemnt support to the Trust in their review of an operating remedial system.

Solutia, Inc., Human Health Risk Assessment, Illinois. Prepared a human health risk assessment workplan to follow Superfund guidelines for several abandoned landfill areas and areas downgradient of the landfills. The workplan was accepted by U.S. EPA Region V. A comprehensive human health risk assessment was prepared that evaluated the former land fill areas as well as local residential areas, a creek, and a borrow pit lake. A total of 64 receptor and area scenarios were quantitatively evaluated. Supporting risk modeling included indoor and outdoor air from subsurface soil and groundwater. Activities included site visits, meetings with personnel from USEPA Region 5 and their contractors, and preparations of responses to comments and document revisions. The human health risk assessment has been accepted by the agency, and the results are being used to guide the feasibility study and remedy selection.

Sauget Area 2 Sites Group, Human Health Risk Assessment, Illinois. Prepared a human health risk assessment workplan to follow Superfund guidelines for a set of sites that include abandoned landfill areas. Activities included a site visit, meetings with USEPA Region 5 and their contractors, and preparation of responses to comments. Conducting the multireceptor, multi-pathway human health risk assessment, including vapor intrusion modeling for both indoor and outdoor air.

Admiral Home Appliances, Human Health Risk Assessment, South Carolina. Prepared a human health risk assessment workplan following U.S. EPA Region 4 guidance for a site being evaluated under Superfund guidelines.

Columbia Gas Transmission, Strategic Risk Assessment Advisor, West Virginia. Serving as strategic risk assessment advisor to a multi-site, ten-state AOC with U.S. EPA Region III. Responsibilities include review of other contractor reports, development of a common strategy for TPH and mercury to be used in the program, review and summary of risk assessment regulations and guidance for each of the states (Ohio, Pennsylvania, West Virginia, Virginia, Kentucky, North Carolina, Delaware, New Jersey, Maryland, New York, and Louisiana), and conduct risk assessments.

Tippecanoe Landfill, Human Health Risk Assessment, Indiana. Conducted agency negotiations (U.S. EPA Region V) concerning the human health risk assessment for a Superfund site. Because arsenic concentrations in groundwater were of concern to the agency, researched and reviewed the toxicological information available for arsenic, and prepared a literature review and critique of the current dose-response values developed by the U.S. EPA for arsenic.

Industri-Plex CERCLA Site, Risk Assessment Review and Strategy for PRP Group, Massachusetts. Providing risk assessment review and strategy for PRP group, and developed risk assessment workplan to address surface water and groundwater exposure pathways. Providing comments on the Agency's RI/FS document and Proposed Plan including a human health risk assessment.

Manufacturer, Human Health Risk Assessment, South Carolina. Conducted the human health risk assessment under the purview of USEPA Region IV, for a CERCLA site that was a former manufacturing facility. Employed both the child and adult lead models to evaluate remedial goal options. Incorporated fate and transport modeling to evaluate future groundwater and surface water exposure pathways.

Tennessee Valley Authority, Human Health Risk Assessment, Tennessee. Prepared human health risk assessment and developed target cleanup levels for an abandoned battery manufacturing site. Primary constituent was lead and both child and adult lead models were used in the evaluation.

Confidential Client, Human Health Risk Assessment, New Jersey. Conducted a human health risk assessment for a school district's baseball fields located adjacent to a potential Superfund site. Report was prepared for community distribution, and results presented at a public meeting.

Confidential Client, Human Health Risk Assessment, New Jersey. Conducted a preliminary human health risk and ecological assessment for a site being considered for inclusion on the NPL using data available for the site. The preliminary risk assessment formed the basis of a Work Plan for the site, was used to identify areas of uncertainty that could benefit from further research, and included evaluation of local state biological water quality criteria.

Old Southington Landfill, Human Health Risk Assessment, Connecticut. Managed and conducted a human health risk assessment for a Superfund site. The site was a former landfill that is currently used for both residential and industrial purposes. Project included meetings and negotiations with U.S. EPA Region I.

Motco Superfund Site, Review of AIC for Volatile Organics, Texas. Reviewed U.S. EPA-developed acute inhalation criteria (AIC) for volatile organics. Developed a consistent and scientifically-defensible methodology for AIC development, and applied this methodology to provide alternative AICs for use at the site.

Brio Site Task Force, Texas. Developed acute inhalation criteria for use in a remedial program for benzene, 1,1-dichloroethane, 1,2-dichloroethane, ethyl benzene, methylene chloride, styrene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, and vinyl chloride.

A. Representative RCRA Experience

Solutia, Inc., Human Health Risk Assessment Oversight for the J.F. Queeny Facility, St. Louis, Missouri. Providing oversite for the human health risk assessment being prepared for the facility under an order with USEPA Region 5. The risk assessment is designed to meet the requirements of both USEPA and the State of Missouri Risk-Based Corrective Action Program.

Solutia, Inc., Human Health Risk Assessment Workplan for the W.G. Krummrich Facility, Sauget, Illinois. Developed the human health risk assessment workplan of the RCRA Sampling Plan for Solutia's W.G. Krummrich Facility. The workplan was designed to permit evaluation of the "Human Exposures Environmental Indicator" as well as human health risk.

Solutia, Inc., Human Health Environmental Indicator Risk Assessment Workplan for the Flexsys America, L.P. Facility, Nitro, West Virginia. Developed the human health risk assessment workplan to address the RCRA Human Health Environmental Indicator (CA725) for the facility. The workplan was designed to permit evaluation of the "Human Exposures Environmental Indicator" as well as human health risk.

U.S. Steel, Human Health Risk Assessment, Gary, Indiana. Developed the RCRA RFI Human Health Risk Assessment Workplan for the U.S. Steel Gary Works. Activities have included response to regulatory comments on previous reports, site visits, review of reports generated both by USS and by local groups about the facility and its environs, development of the risk-related portions of the facility-wide RCRA RFI workplan, in addition to the HHRA workplan, and agency negotiation.

U.S. Steel, Human Health Risk Assessment, Gary, Indiana. Participated in strategy development for and preparation of the human health sections of the Sampling and Analysis Plans for each of the Solid Waste Management Areas being addressed at Gary Works under RCRA (13 in total).

U.S. Steel, Human Health Risk Assessment, Gary, Indiana. Managed and prepared the human health risk evaluation of perimeter groundwater data. Work included conducting a two tiered well-by-well screening (55 wells total). The first tier comparison was to generic and readily available standards, and the second tier took into account background and dilution into receiving water bodies, and evaluated construction worker and indoor air scenarios.

U.S. Steel, Human Health Risk Assessment, Fairless Hills, Pennsylvania. Prepared the human health risk evaluation under RCRA Corrective Action for a parcel of property to be leased by U.S. Steel at Fairless Works. The work was conducted to satisfy Pennsylvania Department of Environmental Protection (PADEP) requirements under the Pennsylvania Act 2 program, as well as USEPA Region 3 requirements. Activities included site visit, meetings and presentations to both agencies, as well as preparation of memoranda and reports. Included in the evaluation was a sensitivity analysis of the parameters used to evaluate a construction worker scenario; site-specific parameters, parameters from the scientific literature, and parameters provided by the agency were evaluated. Currently developing a site-wide approach to risk assessment to satisfy both Act 2 and Region 3 requirements.

U.S. Steel, Human Health Risk Assessment, Fairfield, Alabama. Developed the RCRA RFI Human Health Risk Assessment Workplan for the U.S. Steel Fairfield Works under USEPA Region 4 and Alabama Department of Environmental Management (ADEM) requirements. Activities included site visits, preparation of strategy, review of the full RFI workplan to ensure consistency with risk objectives, and preparation of responses to agency comments. Work included a detailed evaluation of USEPA's current and proposed adult soil ingestion rates.

Alside, Human Health Risk Assessment, Cuyahoga Falls, Ohio. Prepared a work plan and human health risk assessment report for a facility as part of a RCRA Facility Investigation under U.S. EPA Region V. Constituents of interest included metals in soils and groundwater.

Gold Mills, Human Health Risk Assessment, Pine Grove, Pennsylvania. Prepared the human health risk assessment for the RCRA Facility Investigation Report under U.S. EPA Region III. Constituents of interest included chlorinated solvents. Fate and transport models were used to evaluate movement within groundwater and to evaluate vapor transport of constituents from groundwater to indoor air as well as vaporization of constituents from groundwater used as process water.

Con Edison, Human Health Risk Assessment, New York. Conducted a human health risk assessment for a portion of the Con Edison Astoria facility under a state-led RCRA program. Constituents of interest included PCBs and metals. Remaining areas of the facility will be addressed once the investigatory data are available.

Sun Oil Company, Health Assessment of RCRA Facility, Philadelphia, Pennsylvania. Prepared the Health Assessment of the RCRA Facility Investigation for Sun's Philadelphia Refinery. Developed Action Levels for the chemicals of concern in each solid waste management unit. In addition, prepared and presented in the RFI preliminary Media Cleanup Standards for each unit.

Pulp and Paper Industry Client, Human Health Risk Assessment, USEPA Region III. Prepared a human health risk assessment for a process ditch at a facility undergoing state-led corrective action. The facility had been prepared to spend upwards of a million dollars under capital projects to address the ditch, but the results of the risk assessment indicated that the expenditure was not warranted on a health risk basis.

Solar Turbines, Inc., Human Health Risk Assessment, California. Conducted a human health risk assessment as a component of the closure of seven hazardous waste management units and RCRA Corrective Action as administered by the State of California.

C. Representative Risk Assessment Experience Under Other Programs

Bureau of Land Management, Environmental Impact Statement, Western States. Developing human health risk assessment to evaluate five pesticides proposed for use in BLM vegetation treatment programs. Risk assessment uses standard USEPA Office of Pesticide Policy risk assessment methods and includes use of the AgDRIFT model to evaluate off-site spray drift and deposition, and transport models to evaluate surface water impacts. Worker, public and Native American subsistance receptors are evaluated. Work has included interagency scoping meetings.

Confidential Client, Indiana. Evaluated groundwater and soil gas data for vapor intrusive to indoor air using the USEPA version of the Johnson and Ettinger model. Used the Johnson (2002) sensitivity analysis method to ensure that critical model parameters were within acceptable/realistic ranges. Provided deposition testimony and testimony in a court hearing on both the vapor intrusion pathway risk assessment and the toxicology of benzene.

U.S. Steel, Development of a Standardized Risk Evaluation Guidance Manual, Pennsylvania. Worked in conjunction with another firm and USS personnel to develop a standardized Risk Evaluation Guidance Manual for USS. The manual addresses important issues in human health and ecological risk assessment, provides background for the issues, USS strategy to address the issues, and examples of standard language and references to be used in future USS reports. The manual will allow for more cost-effective and consistent risk evaluations to be conducted for USS facilities and sites.

U.S. Steel, Review and Comment on Indiana's RISC Program, Indiana. Reviewed several draft versions of Indiana's "Risk Integrated System for Closure" guidance, and submitted comments to the agency. Detailed comments were provided on the following topics: construction worker soil ingestion rate, soil saturation limit, arbitrary caps for metals concentrations in soil. Have also prepared comments on Indiana's draft groundwater policy and The User's Guide that details how the RISC program will be applied to RCRA sites under state authority.

U.S. Steel, Human Health Risk Assessment, Fairfield, Alabama. Conducted a human health risk evaluation for a parcel of property to be leased by U.S. Steel at Fairfield Works. Activities included evaluation of a construction worker scenario, and use of the Johnson & Ettinger and ASTM models to evaluate indoor and outdoor air.

Moen, Human Health Risk Assessment, Pennsylvania. Conducted a human health risk assessment in support of a remedial action alternatives evaluation. Work was conducted to be consistent with the Pennsylvania Act 2 environmental program. Of interest were chlorinated solvents in groundwater. Target levels for constituents of interest were developed for surface water based upon reasonable exposure scenarios. The target levels will be used to determine the efficacy of on-going remedial actions.

Confidential Railroad Client, Evaluation of Data, Pennsylvania. Conducted detailed evaluation of data collected from a rail yard consistent with the Pennsylvania Act 2 environmental program. Oversaw the development of a database of the Act 2 standards to be used for facile screening of large amounts of data. Prepared report summarizing the results.

Latham and Watkins, Litigation Support, Los Angeles, California. Provided litigation support in a trial over a property's value and environmental liabilities. Conducted risk screening evaluation of available site data, and provided support to lawyers taking deposition of opposing risk assessor/toxicologist.

Confidential Client, Risk Assessment Support, Pennsylvania. Provided risk assessment support during year-long negotiations with regulatory agency covering multiple sites within the state. Developed risk-based action level for diesel fuel TPH based on direct contact and soil-to-groundwater pathways.

Bridgestone/Firestone, Development of Risk-Based Cleanup Levels for TPH and Lead in Soils, Texas. Developed risk-based cleanup levels for TPH and lead in soils based on the protection of underlying groundwater quality under the TNRCC Leaking Storage Tank Program. TNRCC's approval allowed for the timely remediation of the site for subsequent sale.

Con Edison, Risk Assessment Project, New York. Conducted the risk assessment project associated with Con Edison's Spill Remediation Program, a part of the Order on Consent with NYSDEC. Developing a risk-based concentrations (RBC) for the spill materials included in the program based on a matrix of potential spill location exposure scenarios. Both direct contact and groundwater pathway exposures are addressed in the program. ENSR developed a screening procedure to be used in conjunction with the RBC to enable Con Edison to address and close spill sites in both a cost-effective and health-protective manner. There is ongoing interaction with NYSDEC Spills Program and headquarters personnel in the project.

Stanley Structures, Plan B Exposure and Risk Assessment, Texas. Performed a Plan B Exposure and Risk Assessment under the TNRCC Leaking Storage Tank Program. Results indicated that no further action was warranted for the site and allowed for closure of a real estate transaction.

Computer Manufacturing Facility, Risk Assessment for Diesel Fuel TPH in Soil, Arizona. Conducted a risk assessment for diesel fuel TPH in soil at a facility sold by the client, but for which the client maintained environmental liability. Demonstrated using literature data on the components of TPH that the site met the state's cleanup criteria for TPH and its individual components. Agency approval for site closure was obtained. This project was the first risk-based closure under the State of Arizona's Soil Remediation Standards Rule. Use of literature data on diesel composition eliminated the need for additional environmental sampling, reducing project costs. Achievement of official risk-based closure saved the client additional remedial costs and eliminated liability for the property, allowing the real estate transaction to close.

Confidential Client, Technical Review of State-Sponsored Monitoring Program, Idaho. Provided a pulp mill facility with technical review of a state-sponsored air monitoring program conducted in the vicinity of the facility. Provided information on background levels of chloroform in urban and rural areas of the U.S. to support the conclusion that the locally measured concentrations were not significantly different from those for other regions of the U.S. Informed the client and the state about new information on the toxicology of chloroform that is likely to change how chloroform is regulated by the U.S. EPA.

Confidential Client, Peer Review, Alaska. Provided peer review for a risk assessment of air emissions performed for a pulp mill in Alaska. Brought to the attention of the client the overly conservative nature of the assessment. In addition, informed the client of new information on the toxicology of chloroform that would have a direct bearing on the risk estimates for the facility. Based on this review, provided senior oversight for the revisions made to the risk assessment before its submittal to the state.

Confidential Client, Peer Review, Alaska. Provided peer review for a distributional (Monte Carlo) analysis of risk for human health risk assessment of chloroform associated with pulp mill emissions.

Arizona Department of Environmental Quality, Human Health Risk Assessment Implementation, Four Regions, Arizona. Implemented the human health risk assessment for hazardous air pollutants for the State of Arizona in response to a legislative mandate. Four regions of Arizona were chosen for study based on population and geographical characteristics. An inhalation risk assessment was performed for all four regions. Preliminary analyses indicated that a multipathway risk assessment was not warranted. The assessments were based on a detailed emissions inventory and gridded air dispersion model for each region. Risk was evaluated for current conditions as well as conditions predicted upon implementation of controls mandated by the 1990 Clean Air Amendments. The final report was submitted to the Office of the Governor

National Oil Company, Human Health Risk Assessment, Virginia. Conducted human health risk assessment for a gasoline and fuel oil holding facility. Developed a toxicity ranking scheme for PAH that do not currently have EPA derived oral Reference Doses. Used the results of the risk assessment and ranking scheme to develop target cleanup levels for PAH in soils and groundwater.

Hazardous Waste Incinerators, Human Health Risk Assessment. Managed the multi-pathway human health risk assessment for the permitting of a proposed facility. Developed toxicological parameters for specific chemicals of concern for use in human health risk assessments for proposed facilities.

Former Industrial Plant Site, Developing Clean-up Levels for PAHs, Michigan. Developed health-based target cleanup levels for PAHs and related compounds for soils and for a perimeter air monitoring program for a tar and oil containing site. Incorporated comparative potency rankings and in situ degradation rates in the development of target cleanup levels.

National Oil Company, Human Health Risk Assessment, Massachusetts. Management of human health risk assessment for a former tank farm facility under the Massachusetts Contingency Plan. Provided critical input on proposed field sampling plans. Identified issues of potential concern at the site by analyzing risks using maximum detect data. Information was used to develop site specific assumptions to be used in the risk assessment.

Unocal Corporation, Health Risk Assessment, Rodeo, California. Health risk assessment task manager for the Unocal San Francisco Refinery Reformulated Gasoline Project. Tasks include preparation and submission to the agency of a protocol for the health risk assessment.

Litigation Support, Massachusetts. Conducted a human health risk assessment following Massachusetts guidelines for a field on which wastewater sludge from a juice manufacturing facility had been applied. Report was prepared for submittal to both parties in the suit.

Beal and Company, Human Health Risk Assessment, Massachusetts. Conducted a human health risk assessment and developed target cleanup levels for soils at a site on which a leaking underground storage tank had been previously located.

Bridgestone/Firestone, Human Health Risk Assessment, Alabama. Developed a site-specific human-health risk based target cleanup level for total petroleum hydrocarbons (TPH) in subsurface soils at a former automobile lubrication facility, based on the components of the lubricating and waste oils used at the site. Results were submitted to the State of Alabama as an alternative to the State's generic TPH target cleanup level.

Confidential Client, Michigan. Developed risk-based air concentrations for subchronic exposures to wood tar constituents for use in a remedial program.

Department of Environmental Quality, Arizona. Developed the risk assessment component of a legislatively mandated hazardous air pollutant (HAP) research plan for the ADEQ. The research plan was developed to aid in the developed of risk assessment guidance for the state's HAP program in compliance with the Clean Air Act.

SnyderGeneral, Inc., Human Health Risk Assessment, Texas. Conducted a human health risk assessment that evaluated exposures to groundwater containing chlorinated solvents for a facility in California.

Confidential Petroleum Company. Prepared a risk assessment generic standard language document, including selection of exposure scenarios and exposure parameters, for use in an in-house risk assessment system for fuel stations. The prepared document prompted users to enter site-specific data, provided example tables, and prompted user to include or delete receptor/exposure pathway text as appropriate to the specific site.

Confidential Petroleum Company, Human Health Risk Assessment, Rhode Island. Conducted a human health risk assessment for the development of target cleanup levels for an industrial facility. Results were used as litigation support. Dispute settled out of court in favor of the client.

Confidential Client, Arizona. Provided expert review of a risk assessment for submittal to the TNRCC (Texas) prepared by the seller of a parcel of land being considered for purchase by the client.

D. Representative Toxicology Experience

Utility Solid Waste Activities Group (USWAG), Washington, DC. Provided oversight of comments developed on the proposed listing of naphthalene as a carcinogen by the National Toxicology Program, and on the USEPA's childhood cancer document.

Electric Power Research Institute, California. Worked with another ENSR toxicologist to develope a critiquie of the benzo(a)pyrene toxicity value developed by the United Kingdom for their Contaminated Lands program.

Confidential Natural Gas Client, Toxicity Assessment, Ohio. Provided toxicity assessment of cleaning compounds proposed for use in the decommissioning of a natural gas pipeline laid on the bed of a reservoir that serves as the primary drinking water source for a community. Demonstrated that even should a catastrophic release of cleaning fluid and/or PCBs occur, human and ecological health would not be adversely affected and that concentrations at the drinking water intake would be much lower than health-based values or detection limits.

Confidential Client, Toxicology Review, Indiana. Provided a review of the toxicology and potential carcinogenicity of two structurally similar proprietary industrial chemicals. Used recent data on the nongenotoxic/cytotoxic mechanism of action of a class of potential carcinogens to demonstrate that a safe level for worker exposure exists.

U.S. Steel, Relative Toxicity Ranking, Pennsylvania. Conducted a relative toxicity ranking of U.S. Steel's 1996 SARA Title 3 Section 313 Toxics Release Inventory (TRI) based on available human health and ecological toxicity criteria. Report was prepared to support facility personnel field questions from the public about the TRI.

National Industrial Dry Cleaning Company, Literature Review, Texas. Analyzed the current literature on the toxicity and carcinogenicity of an important industrial chemical, tetrachloroethylene. Reviewed the findings and summarized their regulatory implications in a report to the client.

Industrial Trade Organization, Review of Toxicology Profiles. Reviewed toxicology profiles compiled for 30 compounds of concern to the industry. Reviewed the derivation of the RfD's for methanol and acetone, and proposed alternate values based on analysis of the literature.

National Oil Company, Massachusetts. Due to the provisional status of the state-derived dose-response value for methyl-tert-butyl ether, a compound of major importance at the site, performed a thorough study of the toxicity of the compound. ENSR's input into the state's review of the dose-response value had a direct impact on the state's decision to revise the dose-response value. This revision stands to greatly reduce the client's remedial costs.

U.S. Environmental Protection Agency, Literature Review. Developed a strategy for evaluating absorption data in the literature and applied it to the development of absorption adjustment factors for oral and dermal exposures to soil and water for 5 metals of concern at hazardous waste sites (arsenic, cadmium, chromium III, chromium VI, inorganic mercury, organic mercury, and nickel) based on a thorough review of the literature.

Georgia Pacific, Literature Review, Georgia. Reviewed literature and summarized the current scientific knowledge of the endogenous synthesis of halogenated compounds in humans.

Confidential Client, Literature Review, New York. Developed an oral reference dose for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) for use in a human health risk assessment for a hazardous waste incinerator, based on review of the literature and current regulatory guidance.

E. Representative MGP Experience

Natural Gas Company, Risk Assessment Advisor, Ohio. Serving as strategic risk assessment advisor to the manager of MGP sites.

Natural Gas Company, Former MGP Site Advisor, Wisconsin. Have reviewed remediation plans and fenceline monitoring plans, gave presentation at public meetings discussing the air monitoring plan, and have reviewed fenceline monitoring data for a remediation project.

Energy Company, Former MGP Site Review, Rhode Island. Provided senior review of an air monitoring program and identified where flexibility can be used in the development of fenceline air monitoring standards.

Village of Oak Park, Former MGP Site Advisor, Illinois. Have provided senior review of remediation plans, and fenceline monitoring plans, and provided air monitoring data evaluation. Have been involved in regulatory meetings, negotiations, and presentations to the Village council. Have also conducted public meetings concerning air monitoring aspects of the project.

Publications

Bradley, L.J.N., K. Sullivan, and M. Garcia. "Background Levels of Benzene in Indoor and Outdoor Air." Paper presented at the Gas Technology Institute's Natural Gas Technologies II Conference, Phoenix, Arizona. February, 2004

Bradley, L.J.N., M. Garcia, and K. Sullivan. "Background Levels of Benzene in Indoor and Outdoor Air." Poster presented at the Midwestern States Risk Assessment Symposium, Indianapolis, Indiana. August, 2004.

Bradley, L.J.N., and K.A. Sullivan. "Risk-Based Action Levels for Remediation Project Fence-Line Air Monitoring Programs." The Toxicologist. 72(S-1): 395. March, 2003

Bradley, L.J.N., and K.A. Sullivan. "Risk-Based Action Levels for Perimeter Monitoring Programs at MGP Sites." Paper presented at the October 2002 UMass Soils Conference, Amherst, MA.

Bradley, L.J.N., and M. Gerath. "Generic Risk and Fate Analysis for Mercury at Natural Gas Meters." Paper presented at the December 1998 Society for Risk Analysis Annual Meeting, Phoenix, AZ.

Bradley, L.J.N. and M. Gerath. "Generic Screening Level Fate and Transport Analysis for Mercury at Natural Gas Metering Sites." Poster presented at the October 1998 Contaminated Soils Conference, Amherst, MA.

Bradley, L.J.N., K.B. Lemieux, M.C. Garcia, A.H. Parsons, and D.E. Rabbe. "Comparison of Concentrations of Selected Metals and Organics in Fish Tissue and Sediment in the Grand River, Ohio, and the Southern Lake Erie Drainage Basin." Human and Ecological Risk Assessment 4(1):57-74 (1998).

Bradley, L.J.N. "TPH Analyses Provide Means of Direct Assessment of Diesel Releases." Paper presented at the October, 1997, Contaminated Soils Conference, Amherst, MA.

Bradley, L.J.N. "Risk Assessment of Hazardous Air Pollutants in Arizona." Paper presented at the December, 1996 Society for Risk Analysis Annual Meeting, New Orleans, LA.

Bradley, L.J.N. "Cost-Effective Use of Tiered Approaches in Risk Assessment." Paper presented at the October, 1996 Annual Conference on Contaminated Soils, Amherst, MA.

Bradley, L.J.N. "Role of Risk Assessment in Environmental Management." Invited paper presented at the West Virginia Manufacturers Association Environmental Compliance Conference, May, 1996, Charleston, WV.

Bradley, L.J.N. "New Toxicology Data for Chloroform: Implications for the Pulp and Paper Industry." Proceedings of the 1996 Environmental Conference of the Technical Association of the Pulp and Paper Industry. Vol 1, pp. 13-16 (1996).

Bradley, L.J.N. "Ingested Arsenic - Are the Taiwanese Data Appropriate for Risk Assessment in the U.S." Paper presented at the December, 1994, Society of Risk Analysis Conference, Baltimore, MD.

Bradley, L.J.N. "Background Levels of PAH in Urban Soils." Invited paper presented at the March, 1994, Contaminated Soils Conference, Long Beach, CA.

Magee, B.H., and L.J.N. Bradley. "Absorption Adjustment Factors for Use in Risk Assessment." Proceedings of the International Congress on the Health Effects of Hazardous Waste. (1994).

Bradley, L.J.N., B.H. Magee, and S.L. Allen. "Background Levels of Polycyclic Aromatic Hydrocarbons and Selected Metals in New England Urban Soils." J. Soil Contam. 3(4):349-361. (1994).

Bradley, L.J.N. "Background Levels of PAH in Urban Soils." Paper presented at the September, 1993, Contaminated Soils Conference, Amherst, MA.

Bradley, L.J.N. "Absorption Adjustment Factors for Use in Risk Assessment." Poster presented at the May, 1993, International Congress on the Health Effects of Hazardous Waste, Atlanta, GA.

Magee, B.H., L.J.N. Bradley, E.L. Butler, A. Dasinger, J. Grabowski. "Risk-Based Target Clean-Up Levels for TPH in Soils." In: Hydrocarbon Contaminated Soils. Vol. 3. pp. 303-319. edited by P.T. Kostecki and E.J. Calabrese. 1993.

Bradley, L.J.N. "Background Levels of PAH in Urban Soils." Poster presented at the December, 1992, Society of Risk Analysis Conference, San Diego, CA.

Bradley, L.J.N. "Risk-Based Target Cleanup Levels for TPH in Soils." Poster presented at the September, 1992, Hydrocarbon Contaminated Soils Conference, Amherst, MA.

Bradley, L.J.N. "Human Health Risk Assessment Workshop." Presented at the September, 1992, Hydrocarbon Contaminated Soils Conference, Amherst, MA.

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Pinto, A.L., L.J. Naser, J.M. Essigmann, and S.J. Lippard. "Site-Specifically Platinated DNA, a New Probe of the Biological Activity of Platinum Anticancer Drugs." J. Am. Chem. Soc. 108 (1986) 7405-7407.

Bradley, L.J.N., K. Yarema, S.J. Lippard, and J.M. Essigmann. "Mutagenicity and Genotoxicity of the Major DNA Adduct of the Anti-tumor Drug cis-Diamminedichloroplatinum(II)." Biochemistry 32: 982-988. (1993) .

2.0 Comments on Ecological Risk Assessment

Menzie-Cura & Associates, Inc. prepared these comments on the Baseline Ecological Risk Assessment (BERA), Feasibility Study (FS), and Proposed Plan for the Industri-Plex Superfund Site Multiple Source Groundwater Response Plan (MSGRP) Study Area (the Site) in Woburn, Massachusetts. Our comments are based on our review of the portions of the documents that describe work done at or proposed for the Halls Brook Holding Area (HBHA) Pond, the only portion of the site where the US Environmental Protection Agency (USEPA) identified ecological risk.

The comments fall into four main categories:

- **USEPA did not take the limited benthic invertebrate habitat of HBHA Pond into account in their analysis. Even under the best of conditions, HBHA Pond is a stormwater retention basin and not a quality ecological habitat. Remediation to be conducted under USEPA's Proposed Plan will not improve the quality of the benthic invertebrate habitat in HBHA Pond.**
- **USEPA arbitrarily selected a Preliminary Remediation Goal (PRG) for the protection of benthic invertebrates from a limited amount of data. In selecting the PRG of 273 mg/kg for arsenic in HBHA sediments, USEPA ignored data showing no effects on benthic invertebrates at arsenic concentrations over 1,000 mg/kg. They also ignored their own analyses showing that effects on benthic invertebrates were more highly correlated to habitat conditions (dissolved oxygen concentration, acid volatile sulfide concentrations, water depth, and flow) than sediment arsenic concentrations.**
- **National Recommended Water Quality Criteria (NRWQC) for dissolved arsenic were not exceeded in outflow from HBHA Pond under baseflow or storm conditions.**
- **The HBHA Pond in its current condition is currently providing the wetland functions listed in the Massachusetts Wetlands Regulations (310 CMR 10.01(2)) and does not require wetland replication to provide those functions.**

2.1 HBHA Pond Provides Poor Ecological Habitat

USEPA states that the ecological risk they are addressing in HBHA Pond is risk to benthic invertebrates. However, the HBHA Pond was created to serve as a stormwater retention basin, and not ecological habitat. In USEPA's (TTNUS, 2005) Remedial Investigation (RI) report for the site, they state:

> **"The HBHA was constructed as a storm water retention area and control structure as part of an area-wide commercial development project. Based on a review of the limited available information, the design effort was directed towards management of flows during storm conditions and not towards developing a viable wetland habitat."**

HBHA Pond is long (1,100 feet) and narrow (200 feet) with relatively steep sidewalls and maximum and average depths of approximately 25 feet and 9 feet, respectively. The deeper areas occur in the northern and southern portions of the Pond. This design limits the littoral zone, the zone in a pond that provides the highest quality habitat to invertebrates, fish, and wildlife, to a narrow band around the perimeter of the pond.

Because of this design, the HBHA Pond becomes thermally stratified in the summer. In thermally stratified ponds, the hypolimnion, or bottom layer, becomes anoxic in the summer months. These characteristics of a stratified pond have been observed in HBHA Pond.

According to USEPA's technical guidance document on developing bioassessment and biocriteria programs for lakes and reservoirs (USEPA, 2003) and other sources (Moss, 1980), the benthic invertebrate community in the hypolimnion of stratified lakes is usually not abundant or diverse because only a few species of invertebrates are tolerant of low dissolved oxygen concentrations. The main groups of species typically found below the thermocline are chironomid larvae, oligochaete worms, and phantom midge larvae (*Chaoborus*) (Wiederholm, 1980). If anoxia persists in a pond or lake, the invertebrate community in the hypolimnion can be completely absent (USEPA, 2003).

The benthic invertebrate community in the deep sampling stations in HBHA Pond (Stations MC-SED-05 and MC-SED-07) exhibited the characteristics described by USEPA in their guidance document. One organism, a chironomid at MC-SED-05 and *Chaoborus* at MC-SED-07, were observed in each sample. By comparison, the reference pond did not exhibit an abundant or diverse benthic community and had a total of nine organisms in the sample, three of which were *Chaoborus*. This indicates that the depauperate benthic community in the hypolimnion of HBHA Pond is representative of the hypolimnion of seasonally stratified ponds and lakes that exhibit low dissolved oxygen levels.

On another Superfund Site in USEPA Region I with elevated arsenic concentrations in sediment, USEPA has restricted their sediment cleanup alternatives in a kettle pond to sediment above the thermocline. USEPA's (2005) Preferred Alternative for cleanup of Sinking Pond on the W.R. Grace Superfund Site in Acton, Massachusetts, targets sediment above the thermocline for remediation. It is implicit in their Proposed Plan for the W.R. Grace Site, that cleanup of sediments below the thermocline would not improve benthic invertebrate habitat because of the seasonal anoxia in the bottom of the pond. Therefore, USEPA's stated objective for remediation of sediments beneath a thermocline to protect benthic invertebrates in HBHA Pond is inconsistent with their Proposed Plan for a natural water body elsewhere in USEPA Region I.

Under the Proposed Plan for the HBHA Pond, remediation of sediments will occur only in the southern portion of the Pond. Because the bottom waters in the southern portion of the pond are likely to continue to be anoxic in the summer after implementation of the Proposed Plan, the remediation proposed by USEPA for HBHA Pond will not provide better or additional habitat for benthic invertebrates (or fish).

2.2 Selection of the Arsenic PRG for Sediment in HBHA Pond was Arbitrary

USEPA arbitrarily selected the arsenic PRG for sediment from a subset of the existing data from HBHA Pond. They did not use their own analyses reported in the BERA to develop PRGs protective of benthic invertebrates, despite the fact that they performed in-depth analyses of the benthic invertebrate toxicity and community data for the HBHA Pond. Some of the data they ignored were statistical correlations of sediment arsenic concentrations and benthic invertebrate toxicity data. Instead of using these data to develop PRGs, USEPA simplistically selected the lowest arsenic concentration in sediment at which toxicity was measured, ignoring many other sources of information from which to develop a robust PRG. USEPA also ignored their own analyses, which indicated that the greatest correlations were found between benthic community and habitat quality measurements (acid volatile sulfide concentration in the sediment, water depth, dissolved oxygen content of the overlying water, flow regime, and total organic carbon (TOC)). These factors have a greater effect on the benthic invertebrate population in HBHA than contaminant concentrations. In fact, body burdens of arsenic in benthic invertebrates were similar in the deep water stations in HBHA Pond and downstream in the wetlands. This supports the analyses that demonstrate the toxicity to benthic invertebrates in deep water Pond locations is due to causes other than arsenic.

The BERA evaluated four different lines of evidence to assess risk to benthic invertebrates. USEPA performed numerous statistical analyses on the data collected to evaluate these lines of evidence. However, they used only one type of data, the sediment toxicity data, to develop the PRGs. As shown on Table 1, the only evidence of acute or chronic toxicity to benthic invertebrates observed in sediment toxicity tests (except for that which also occurred at reference stations) occurred in the HBHA Pond in samples SD-MC-05, SD-MC-06, and SD-MC-07. USEPA selected the lowest concentration of arsenic in sediment from these three samples as the PRG for the protection of benthic invertebrates. This concentration is 273 mg/kg from SD-MC-06.

In addition to ignoring the other benthic invertebrate analyses conducted at the Site, this PRG also ignores the fact that no effects on benthic invertebrates were observed in other portions of the Site with arsenic concentrations in sediment as high as 1,200 mg/kg. In Section 2.2.3.3 for the FS under "Protection of the Environment", USEPA states:

> **"These results indicate that the toxicity and impairment to benthic invertebrates in HBHA Pond are likely related to the forms of metals in the sediment having higher toxicity and/or bioavailability than the same metals present in sediments downstream. "**

However, they do not present evidence of this rationalization in the FS, and the only evidence they present in the BERA is higher arsenic: iron ratios in sediment at the deeper pond locations (SD-MC-05 and SD-MC-07) only (Table 1). The arsenic:iron ratio and other sediment characteristics at the shallow station in HBHA Pond, SD-MC-06, were similar to those in the downstream sediment samples that had higher arsenic concentrations but no evidence of toxicity.

Figures 1 through 5 are scatter plots of the sediment arsenic data vs. the sediment toxicity data. USEPA's proposed PRG is shown as a red line on each figure. These plots demonstrate that the:

- **PRG of 273 mg/kg is arbitrary with regard to the protection of benthic invertebrates; and**
- **Two deep pond stations, SD-MC-05 and SD-MC-07, are very different from the remainder of the sediment triad sampling stations. These stations are different in habitat type and quality as well as in sediment toxicity.**

In Appendix 7D of the BERA, USEPA performed multivariate analyses of the benthic invertebrate data to evaluate possible correlations among those data, habitat quality information, and the ratio of arsenic:iron concentrations in sediment as a surrogate for potentially available arsenic. They used correspondence analysis and canonical correspondence analysis to perform this evaluation. Their results indicated that the two deep water locations in HBHA Pond were dissimilar with regard to benthic community in comparison to any other site or reference sampling location. When these two stations were taken out of the analysis, the greatest correlations were found between benthic community and habitat quality measurements (acid volatile sulfide concentration in the sediment, water depth, dissolved oxygen content of the overlying water, flow regime, and total organic carbon (TOC)). This indicates that these factors have a greater effect on the benthic invertebrate population in HBHA than contaminant concentrations.

2.3 Arsenic Concentrations in HBHA Pond Outflow do not Exceed NRWQC

The NRWQC for arsenic are not exceeded in the oxygenated surface water and surface water outflow from HBHA Pond. The Multiple Source Groundwater Response Plan Remedial Investigation (RI) report (TTNUS, 2005) included 461 analyses of surface water samples collected throughout the site (not including Reference Areas) under baseflow and storm conditions and analyzed for dissolved arsenic among other parameters. Dissolved arsenic did not exceed NRWQC in any of these samples reported in Tables 4-5e through 4-5i the RI report nor in the data used in the BERA.

Dissolved arsenic concentrations above the chronic NRWQC of 150 ug/l were only detected in water below the oxic/anoxic interface (Ford, 2004; included as Appendix 2D of the RI). Dissolved arsenic concentrations above the NRWQC are confined to the deeper depths within the pond. Dissolved arsenic from the anoxic zone diffuses upward toward the oxic zone and is sequestered during oxidation and precipitation of ferrous iron at the oxic-anoxic interface (Ford, 2004). Under current conditions, the HBHA Pond is continually sequestering arsenic from the bottom anoxic waters. Dissolved arsenic is not exceeding its chronic NRWQC in the oxygenated surface waters and is not being transported out of HBHA pond at concentrations above the NRWQC.

2.4 HBHA Pond Wetland Functions Protected under Current and Proposed Conditions

Wetland functions are being protected in the HBHA Pond under current conditions and would be also under USEPA's Proposed Plan. Therefore, wetland replication is not needed as part of any proposed remediation.

Massachusetts Wetland Regulations (310 CMR 10) list eight interests of wetlands to be protected. Federal and Massachusetts wetland regulations are Applicable or Relevant and Appropriate Requirements (ARARs) for the site. In addition, Massachusetts Department of Environmental Protection (MADEP) guidance for ecological risk assessment (MADEP, 1996), states that each risk assessment must compare concentrations of oil and hazardous material at or from the site to Applicable or Suitably Analogous Standards. MADEP guidance identifies Massachusetts Wetland Regulations as Applicable or Suitably Analogous Standards for wetlands.

HBHA Pond in its current condition provides the following seven functions (interests) regulated under the Massachusetts Wetland Regulations:

- **Flood control;**
- **Storm damage prevention;**
- **Prevention of pollution;**
- **Protection of public and private water supply;**
- **Protection of ground water supply;**
- **Protection of fisheries; and**
- **Protection of wildlife habitat.**

The wetland function "protection of land containing shellfish." does not apply to HBHA Pond.

The HBHA Pond in its current condition provides the functions of protection of public and private water supply, protection of ground water supply and prevention of pollution. The bottom of the Pond is anoxic, and benzene that reaches the Pond in groundwater, is biodegraded in the bottom waters. The Pond also serves as an arsenic sink to prevent the further downstream migration of arsenic.

The HBHA Pond was designed to protect the interests of flood control and storm damage prevention, and continues to provide these functions under current conditions.

In its current condition, HBHA Pond does not provide the wetland function of protection of fisheries, except for downstream areas. The pond itself does not provide quality habitat for recreational species of fish, as stated in Section 5.2.2.2 of the BERA, which listed the reasons for this as poor spawning habitat, low dissolved oxygen, poor overwintering habitat, and lack of submerged aquatic vegetation. However, for the most part, the Pond is preventing the further downstream migration of contaminants, and hence protecting fisheries downstream. The same is true for the wetland function of protection of wildlife habitat.

Therefore, wetland functions are being protected in the HBHA Pond under current conditions and therefore, wetland replication is not needed as part of the proposed remediation.

2.5 References

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Table 1
Sediment Arsenic Concentrations and Toxicity Data
Industri-Plex Site
Woburn, Massachusetts

Sed Sample	Location	Location Type	Arsenic mg/kg	As:Fe	Amphipod 10 day Survival (Mean %)	Amphipod 10 day Growth (Mean Weight, mg)	Amphipod 28 day Chronic Survival (Mean %)	Amphipod 42 day Chronic Survival (Mean %)	Amphipod 28 day Chronic Growth (Mean Weight, mg)
SD-MC-12	Halls Brook	Reference Site	22.8	0.00128	94	0.078	92	83	0.277
SD-MC-01	Aberjona River	Reference Site	27.8	0.00143	98	0.138	92	90	0.395
SD-MC-02	South Pond	Reference Site	29.9	0.00117	99	0.129	99	99	0.37
SD-MC-03	Phillips Pond	Reference Site	34.4	0.00124	95	0.088	99	95	0.471
SD-MC-04	Halls Brook	Reference Site	44.5	0.000862	98	0.077	93	93	0.356
SD-MC-06	HBHA Pond	Site-shallow	273	0.00689	94	0.04	60	59	0.159
SD-MC-13	Aberjona River	Site-shallow	339	0.00616	96	0.077	76	73	0.26
SD-MC-08 (ave)	HBHA Pond	Site-shallow	594	0.0054	94	0.02	88	89	0.259
SD-MC-10	HBHA Wetland	Site-shallow	639	0.00674	95	0.132	96	91	0.32
SD-MC-09	HBHA Wetland	Site-shallow	802	0.00723	90	0.056	92	84	0.291
SD-MC-05	HBHA Pond	Site-deep	1103	0.0154	0	0			
SD-MC-11	HBHA Wetland	Site-shallow	1200	0.00870	95	0.137	79	81	0.233
SD-MC-07	HBHA Pond	Site-deep	2390	0.0206	36	0.02			

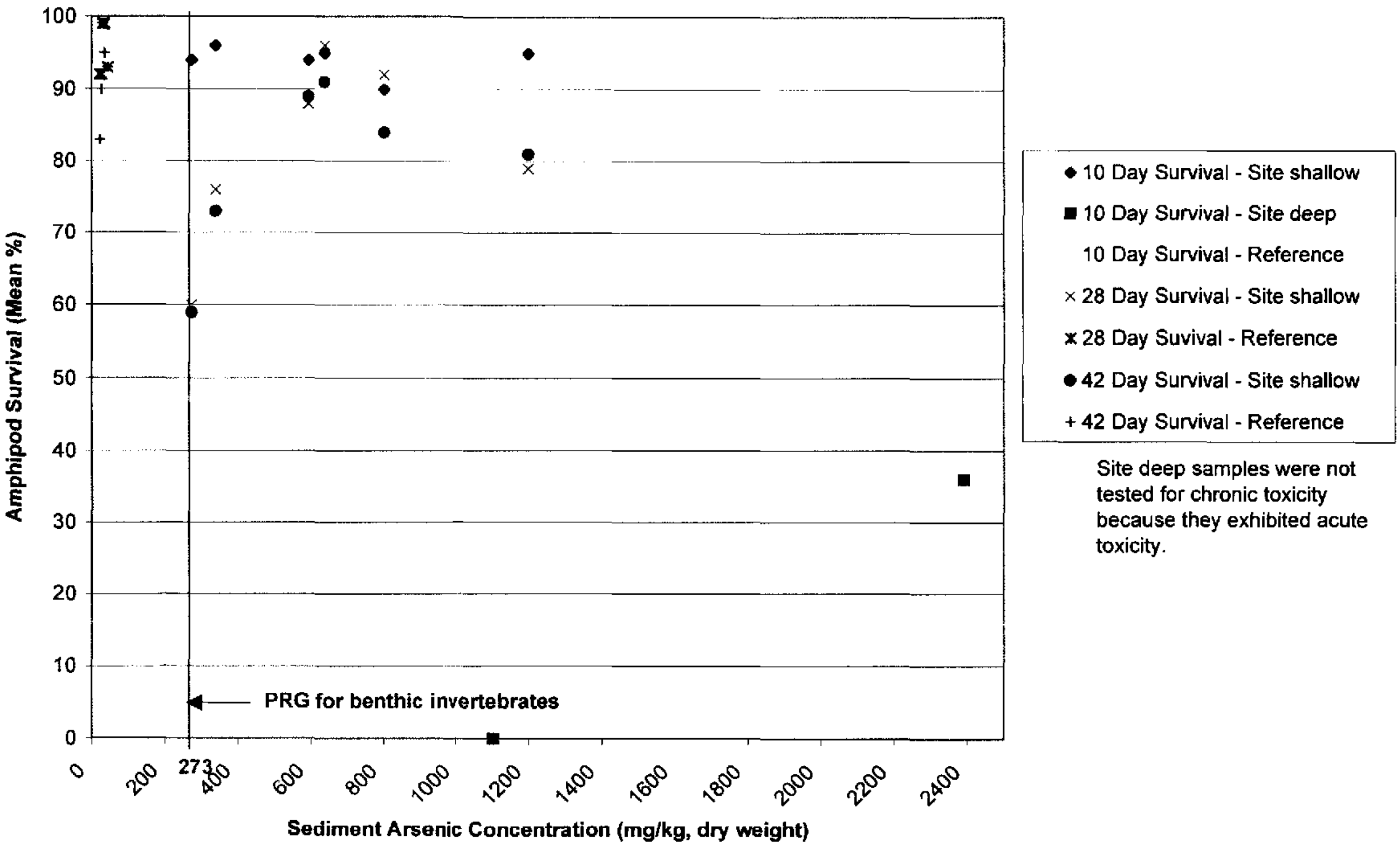
Samples that demonstrated toxicity in 10 days were not carried through chronic toxicity testing.

Table 1
Sediment Arsenic Concentrations and Toxicity Data
Industri-Plex Site
Woburn, Massachusetts

Sed Sample	Amphipod Chronic Reproduction (Mean Number of Neonates/Female)	Chironomid Acute Survival (Mean %)	Chironomid Acute Growth (Mean Weight, mg)	Chironomid Chronic Survival (Mean %)	Chironomid Chronic Growth (Mean Weight, mg)	Chironomid Chronic Emergence (Mean %)	Chironomid Chronic Reproductive Effects (Mean Days Survived, Male)
SD-MC-12	2.8	94	1.836	60	3.027	50	2.6
SD-MC-01	8.9	95	1.36	50	2.838	53	4.9
SD-MC-02	4.3	88	1.629	27	3.459	42	4
SD-MC-03	7.9	98	1.995	46	3.069	55	1.7
SD-MC-04	4.4	99	1.358	38	2.968	45	4.6
SD-MC-06	0.5	94	0.959	19	0.946	18	2.1
SD-MC-13	1.9	84	1.585	65	2.278	30	1.7
SD-MC-08 (ave)	2.5	95	0.997	65	2.578	51	2.7
SD-MC-10	3.3	88	1.596	19	1.213	41	4.1
SD-MC-09	2.4	94	1.076	44	5.619	39	2.8
SD-MC-05		4.5	0.084				
SD-MC-11	1	96	1.292	17	3.933	14	3.6
SD-MC-07		49	0.169				

Samples that demonstrated toxicity in 10 days were not carried through chronic toxicity testing.

FIGURE 1
Scatterplot of Sediment Arsenic Concentration and Amphipod Survival



Site deep samples were not tested for chronic toxicity because they exhibited acute toxicity.

FIGURE 2
Scatterplot of Sediment Arsenic Concentration and Amphipod Growth

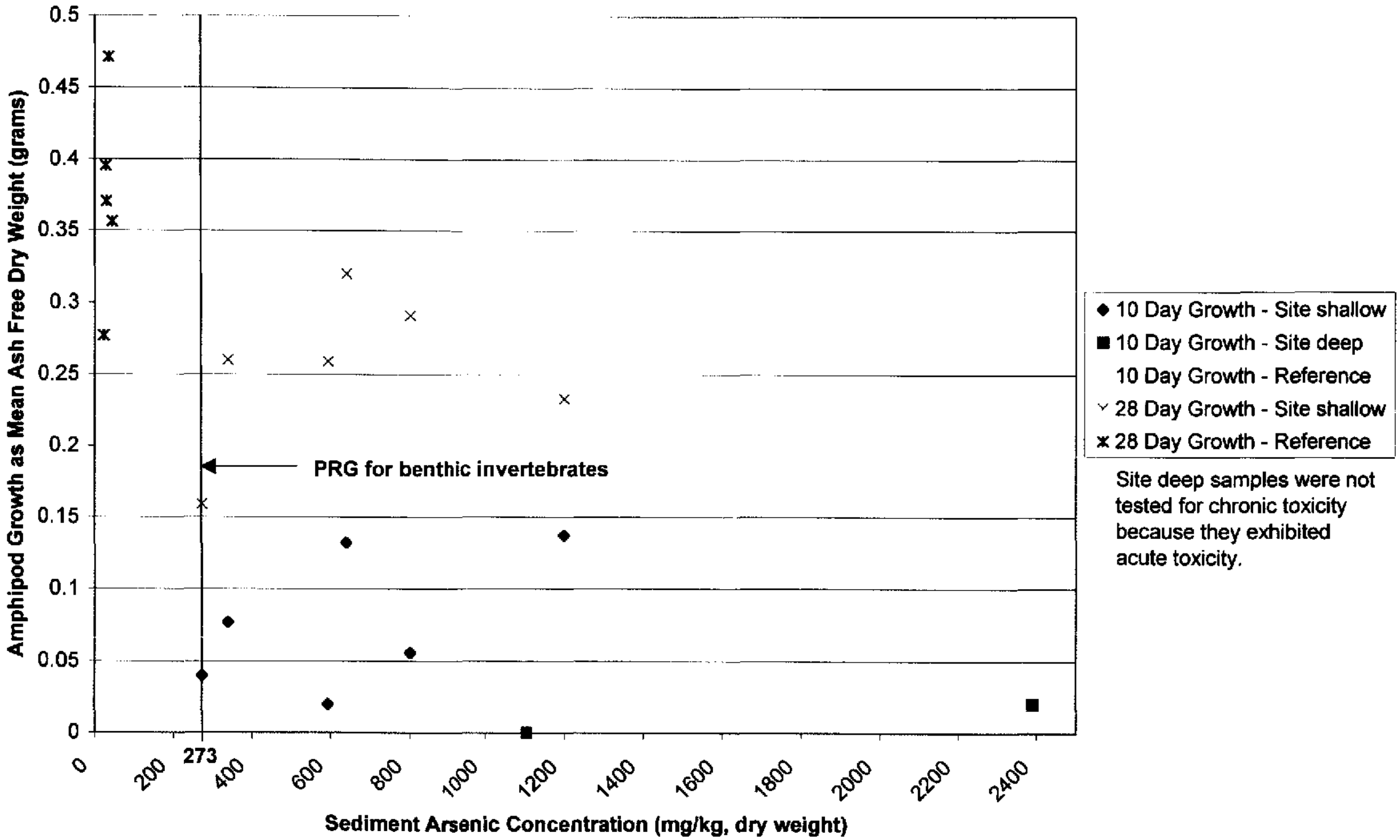
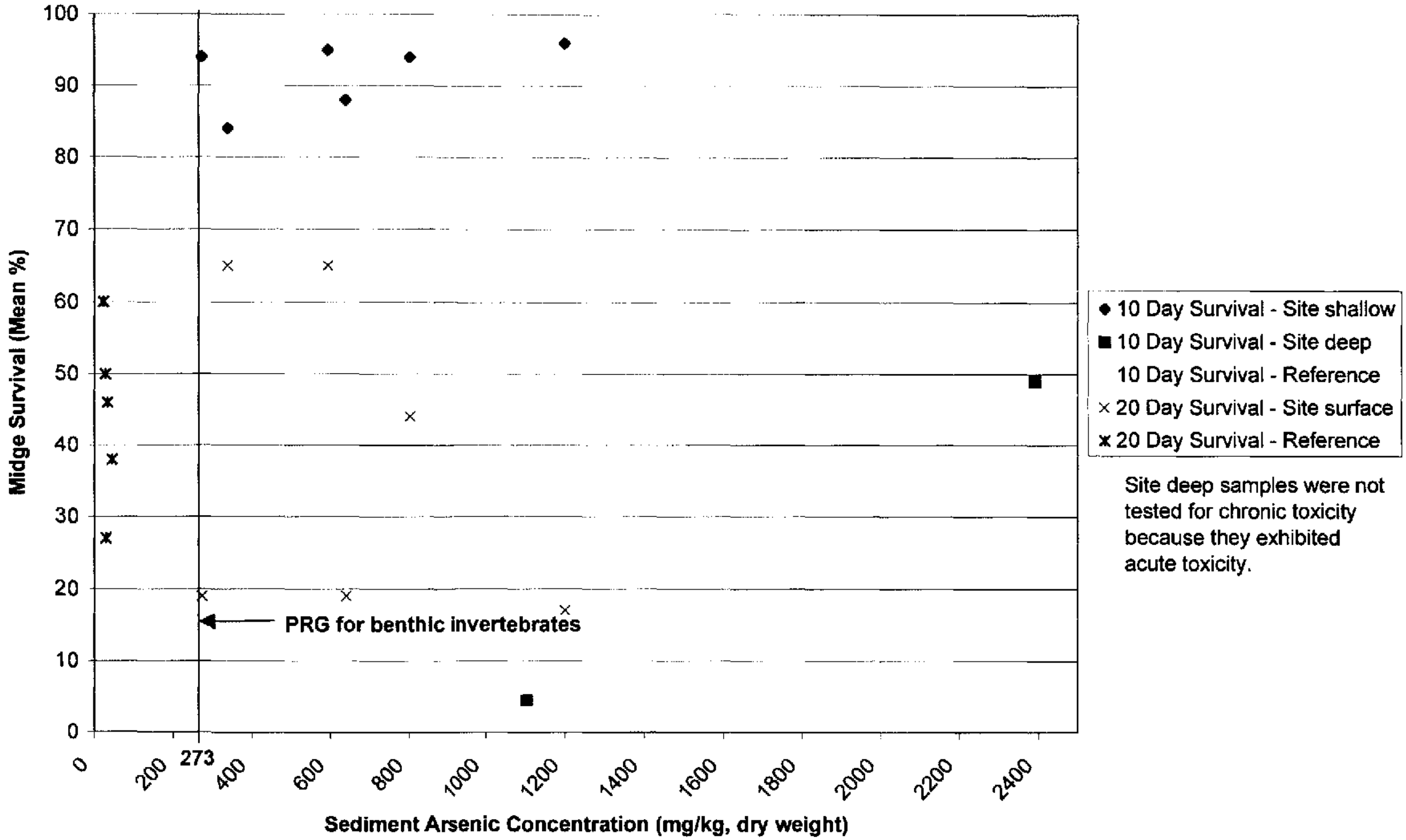
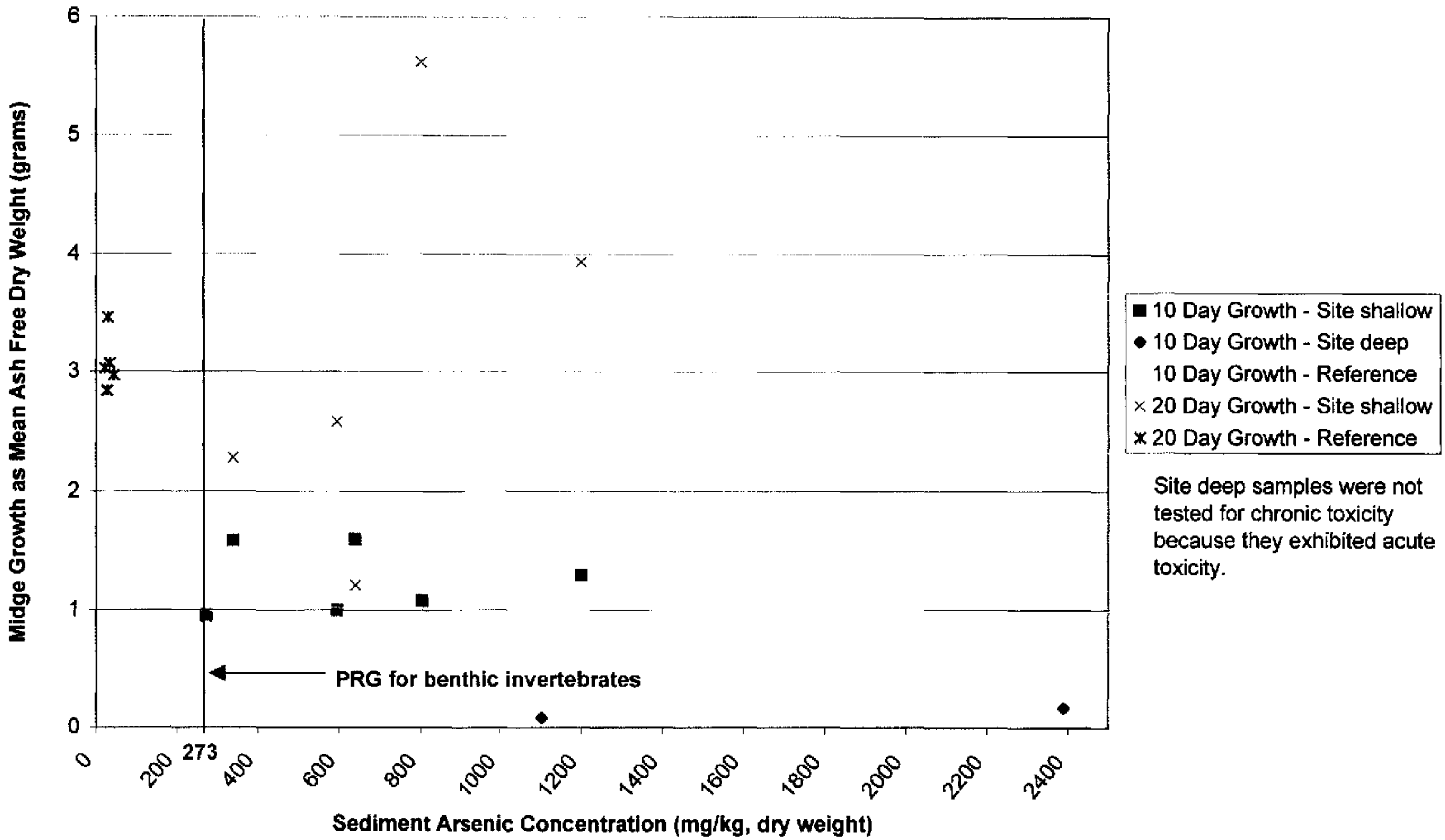


FIGURE 3
Scatterplot of Sediment Arsenic Concentration and Midge Survival



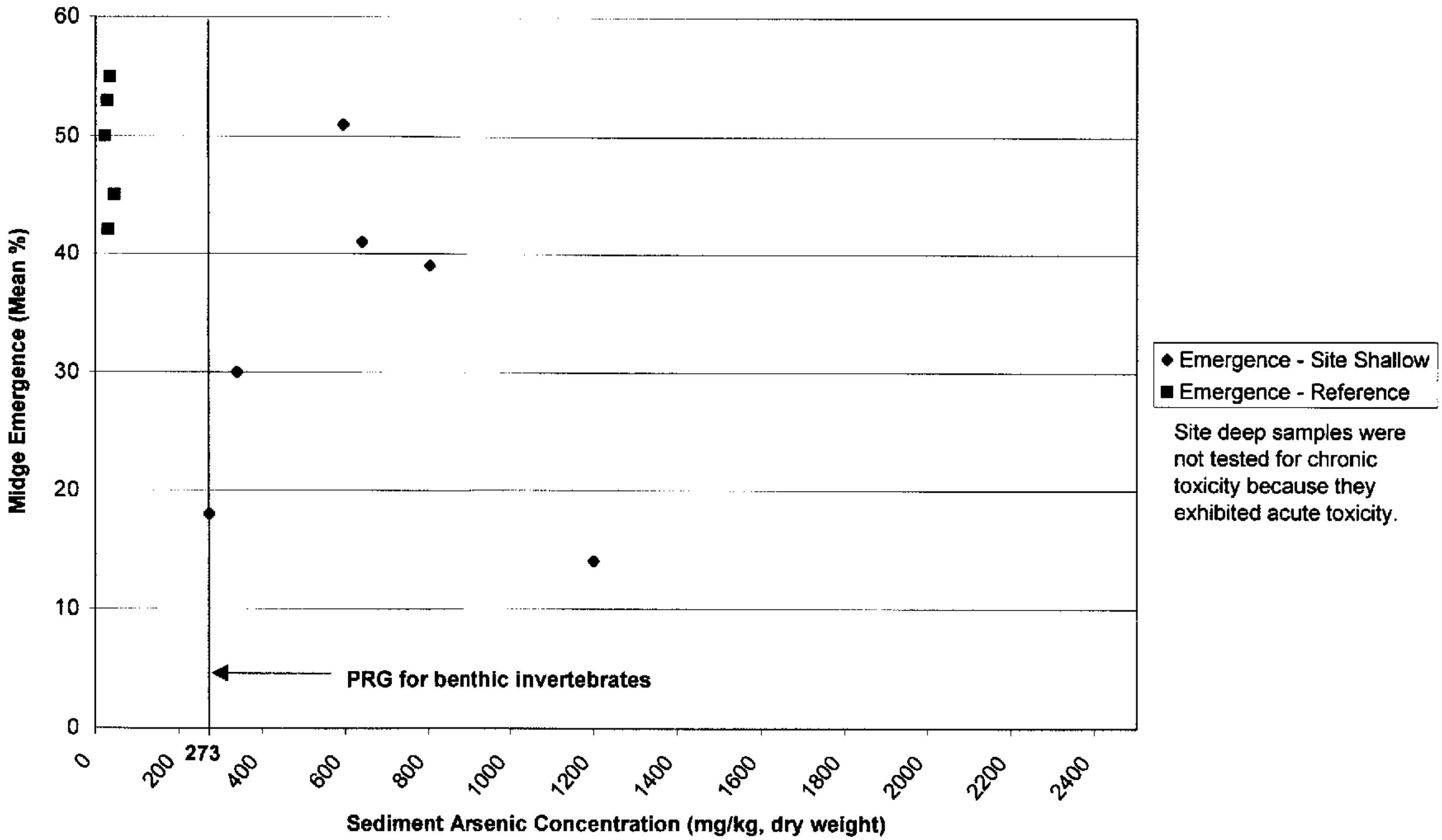
Site deep samples were not tested for chronic toxicity because they exhibited acute toxicity.

FIGURE 4
Scatterplot of Sediment Arsenic Concentration and Midge Growth



Site deep samples were not tested for chronic toxicity because they exhibited acute toxicity.

FIGURE 5
Scatterplot of Sediment Arsenic Concentration and Midge Emergence



KATHERINE A. FOGARTY, P.E., LSP

EDUCATION:

M.S. 1981 Civil Engineering, Parsons Laboratory, Massachusetts Institute of Technology, concentration in aquatic chemistry and environmental engineering

B.S. 1979 Chemistry, Boston College, *magna cum laude*

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Licensed Site Professional, State of Massachusetts, 2004 (License Number 6645)

Professional Engineer, Massachusetts, 1992 (Registration No. 36778)

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OSHA Certified 40-Hours of Training in Hazardous Waste Operations and Emergency Response

OSHA Certified Asbestos Awareness Training Course (Institute for Environmental Education, Inc.), May 4, 2005

EXPERTISE:

Ms. Fogarty has extensive experience managing human health and ecological risk assessments at Superfund and state sites and RCRA facilities. She has fourteen years experience managing projects for Menzie-Cura & Associates, Inc.

Ms. Fogarty specializes in the application of risk assessment methodology to solve contamination problems in groundwater, surface water, soil, and sediment. Her background in engineering allows her to understand and bridge the special needs of risk assessment and remediation.

As an ecological risk assessor, Ms. Fogarty conducts and manages ecological risk assessments including: the development of quality assurance project plans, design and implementation of multi-media field sampling programs, development of conceptual models, application of wildlife exposure models, implementation of weight-of-evidence risk assessment approaches, preparation of final risk characterization reports and risk communication. She incorporates ecological principles in wildlife exposure models and oversees the development of modeling packages to improve the realism of exposure modeling.

Ms. Fogarty is a Registered Professional Engineer and a Licensed Site Professional in Massachusetts. She holds a B.S. in Chemistry from Boston College and a M.S. in Civil and Environmental Engineering from Massachusetts Institute of Technology.

EMPLOYMENT HISTORY:

1991-Present **Menzie-Cura & Associates, Inc**. Senior Environmental Scientist/Engineer. She has managed and/or performed ecological risk assessments at RCRA, Superfund, and state hazardous waste sites nationwide, including Manufactured Gas Plant (MGP) sites. As part of these assessments, she has modeled the fate of nutrients, metals, and synthetic organic compounds in subsurface, river, and estuarine environments. She has also managed hazardous waste site investigation under the Massachusetts Contingency Plan.

1988-1991 **GZA Geoenvironmental, Inc.** Senior Environmental Chemist/Project Manager. Designed and conducted surface water and groundwater chemistry studies on the effect of hazardous material disposal on natural water quality and aquatic ecosystems. Performed ecological risk assessments that include computer simulations of nutrient, metal, and organic chemical fate and transport in subsurface, river, and estuarine environments; developed company ecological risk assessment capabilities. Managed hazardous waste site investigations under Massachusetts General Law Chapter 21E and the Massachusetts Contingency Plan. Developed and managed environmental monitoring programs in support of soil removal and construction projects.

1984-1988 **GZA Geoenvironmental, Inc.** Staff Environmental Chemist. Performed computer simulations of environmental fate and transport of chemicals in the environment for hazardous waste site investigations. Performed laboratory analyses for volatile organic compounds. Served as field/staff chemist on numerous geohydrological site investigations.

1979 **United States Environmental Protection Agency, Region I Laboratory**. Summer Intern. Responsible for preparation of samples and preliminary sample screening by gas chromatography.

PROFESSIONAL ORGANIZATIONS:

American Geophysical Union
New England Estuarine Research Society
Society for Risk Analysis
Licensed Site Professional Association

PUBLICATIONS:

PUBLISHED PROCEEDINGS, CONFERENCES AND SYMPOSIA

R. Schuck, D. Gevalt, J. Mullen, C. Menzie, and **K. Fogarty**. 2003. Risk-based remediation of lead and Chromium Impacted Sediments in Lake Waban, Wellesley, MA: A Case Study. Second International Symposium on Contaminated Sediments. May 26-28, 2003. Quebec, Canada.

C.A. Menzie, **K. A. Fogarty**, and Kenneth M. Cerreto. Using Water Lilies to Evaluate Metals Bioavailability and Exposure. Poster Session, New England Association of Environmental Biologist Annual Conference, April 4-6, 2001.

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3.0 Comments on USEPA's Proposed Plan for Groundwater

Major flaws in USEPA's proposed alternative HBHA-4 relating to arsenic removal in Halls Brook Holding Area (HBHA) Pond identified by Camp, Dresser and McKee are summarized in the following bullet list and then discussed in more detail:

- **The chemocline, in particular the "oxic-anoxic interface" which is one of the processes responsible for arsenic removal, is not "broken down" in the northern end of HBHA Pond during storm events. The oxic-anoxic zone is maintained and is effective in removing arsenic under all conditions. Therefore, construction of a stormwater bypass, sediment retention cell and surface water polishing cell is not necessary or appropriate to maintain the chemocline (in particular the oxic-anoxic transition) and the associated arsenic removal processes in the HBHA Pond.**
- **The two arsenic removal mechanisms occurring in HBHA Pond (1: "sorption to suspended solids produced by iron oxidation-precipitation" and 2: "sorption to solids deposited in the sediments") are effective in removing arsenic from the groundwater as it enters the northern end of the pond. These removal processes are effective in removing arsenic from the groundwater and pond water even during storm events. The second arsenic removal process, sorption onto and removal of the arsenic by the existing sediments in the HBHA Pond, was not adequately evaluated in the Draft Feasibility Study and Proposed Plan. The available, site-specific data showing the long term effectiveness and adsorption capacity of the sediments were not considered by USEPA. Removal of sediments from the HBHA Pond will destroy an effective and important arsenic removal.**

3.1 Stability of the Chemocline in the Northern End of the HBHA Pond

The Draft Final MSGRP Feasibility Study (FS) (USEPA, 2005) and USEPA's Natural Attenuation Study (NAS) (Ford, 2004) identify and call the chemical changes with depth in HBHA Pond the "chemocline". In removing arsenic (see discussion in Section 3.2), the most important aspect of the chemocline is the transition from the oxic to anoxic zone as discussed in the previous paragraph. According to the Draft FS, "This chemocline is critical to sustaining geochemical reactions that are sequestering arsenic within the pond sediments. However, sudden increases in flows, as seen during storm conditions, mix the water column and break down the chemocline thus allowing more arsenic to be "flushed" downstream." (Draft FS, pg 3-29). Contrary to USEPA's conclusion and actual data collected by USEPA after a storm event, the chemocline is not broken down in the northern end of the pond. Immediately following the late March 2001 storm, the oxic-anoxic transition depth was measured in the north part of the pond (WN data, NAS, Table C-11, pg 79) in the water column and in the multi-level sampling station (NML data, NAS, Table C.14, pg 82). The water column measurements (WN data, Table C-11) indicate that the oxic-anoxic transition depth was from 200 - 250 cm (as measured by ORP; no DO measurements were made) and the multi-level measurements indicate that the transition depth was between 220 – 270 cm (as measured by ORP and DO). The oxic zone may have been slightly deeper immediately after the storm as a result of more oxygenated surface water runoff entering the pond. Overall, the important transition from anoxic to oxic conditions still existed in the pond and was not "broken down". In fact, the slightly deeper location of the oxic layer is beneficial in removing the arsenic at a lower depth in the pond. Even if more complete mixing occurred with storm water resulting in more and deeper oxic water, the transition zone would still be present and the arsenic removal would occur at an even greater depth in the pond.

The overall break down of the chemocline has been overstated in the FS. Ford (NAS, pg 49) indicates the "high surface water flow events can perturb the chemical stratification". Actual data following the March 2001 storm event (NAS, figure 7, pg 32) do indicate some depth shift in Specific Conductance between 200 and 350 cm and in dissolved arsenic between 200 and 420 cm. However, the overall transition is still maintained through all sampling events: specific conductance is uniform from the surface to a depth of about 200 cm and then increases; arsenic concentrations are very low (0.010 mg/L) or ND (non-detect) from the surface to the transition depth of about 200 cm (the depth of the anoxic zone) and then increase. As a result of the increase in depth of the oxic zone following the storm event, the arsenic concentration was also below detection limits at a deeper depth (NML-4 on 4/5/01, NAS, pg 82). The Draft Final MSGRP Remediation Investigation (RI) Report (USEPA, 2005) states, "A major surface water runoff event occurred during the study. This resulted in turnover of most of the pond volume and depression of the chemocline at the north end of the pond" (RI, pg 5-34). As stated previously, the chemocline was not broken down in the northern end of the pond, but only depressed (transition zone occurred at a lower depth). This observation is consistent with the actual data collected.

As discussed in detail in the following section, the two arsenic removal processes identified in the FS and the NAS are effective even during and after storm events. Therefore, construction of a stormwater bypass and the Sediment Retention Cell, as proposed in USEPA's Proposed Plan, is not necessary to maintain the chemocline and associated arsenic removal processes. The Surface Water Polishing Cell included in USEPA's Proposed Plan will not remove additional arsenic and is not necessary. The polishing cell is designed to "create a secondary treatment zone that would be utilized to "polish" surface water that leaves the sediment retention area through the use of aeration and sedimentation" (Draft FS, pg 4-28). However, the surface water in the upgradient Sedimentation Retention Cell would be oxic absent any bypass of Halls Brook and contain no reduced iron which is necessary for arsenic removal. Therefore, the Surface Water Polishing cell will provide no additional arsenic removal and is not necessary.

3.2 Arsenic Removal Processes in HBHA Pond

The Natural Attenuation Study (Robert Ford, Natural Attenuation Study, Industri-Plex Superfund Site, September 2, 2004) summarizes the arsenic removal processes in the HBHA Pond: "The mass of dissolved arsenic in the HBHA Pond water column is controlled by a balance between the observed sources and removal processes.... Removal 1) sorption to solids deposited in the sediments 2) sorption to suspended solids produced by iron oxidation-precipitation 3) discharge at the HBHA Pond outlet." (NAS, pg. 39). The first removal process (sorption to pond sediments is discussed in a subsequent paragraph below. The second removal process (sorption to hydrous iron oxides produced by iron oxidation and precipitation) is discussed in the following paragraph.

As stated in the FS and NAS, arsenic continues to diffuse upward from the bottom sediments into the water column where it can be "further sequestered from solution during oxidation and precipitation of ferrous iron at the oxic-anoxic interface" (Draft Final Feasibility Study, Industry-Plex Site, June 2005, pg 1-21). The arsenic is effectively removed from the water column by oxidation of dissolved Fe^{2+} (ferrous iron) to Fe^{3+} (ferric iron), formation of hydrous ferric oxides (HFOs, solid precipitates) and adsorption (removal from solution) of dissolved arsenic onto the HFOs. This process is controlled by the dissolved oxygen (DO) content of the water column. The DO content in the water column in the northern portion of the pond is very low (<1 mg/L) near the bottom of the pond and increases upward to the surface. In the lower part of the water column, the water is reducing (low oxidation/reduction potential (ORP) values) and has elevated concentrations of Fe^{2+}. At the "oxic-anoxic" transition, formation of HFO occurs due to oxidation of the reduced iron and arsenic is removed by adsorption. The depth of the oxic-anoxic transition zone varies somewhat during the year; however in the north part of HBHA pond, the transition depth is typically 200 to 250 cm.

Sediments in the HBHA provide a second important arsenic removal process in the HBHA Pond. This process should be maintained and not disturbed by dredging. As discussed in the Draft FS, "A fraction of the dissolved arsenic being discharged from groundwater in the HBHA Pond sediments becomes bound to ferric oxides and effectively removed from the water column and becomes part of the sediment load." (Draft FS, pg 1-21). "Sediments solids rich in iron, sulfur and organic matter sequester a fraction of the total arsenic at the sediment-water interface." (NAS, pg 39). Although the sediments provide an important arsenic removal function, the NAS indicates that there is "incomplete removal onto sediments" and "It is unclear which of these phases control arsenic partitioning during deposition" (NAS, pg 39). However, the arsenic removal mechanisms and capacity of the HBHA Pond sediments have been previously evaluated using electron microprobe techniques (Supplemental Site Investigation Report, Industri-Plex Site, September 1997, pp 51 – 52), which are included at the end of this section, and batch adsorption tests (Supplemental Site Investigation Report, pp 53 – 55). The Supplemental Site Investigation Report found that natural iron containing minerals in the HBHA Pond sediments were important in removing arsenic from groundwater and that the average removal capacity was over 3,000 mg As/kg of sediment. The NAS (pg 48) indicates that "...it is difficult to assess the long-term capacity of the HBHA Pond." However conservative estimates using the results of the Supplemental Site Investigation Report indicate that the pond sediments will continue to remove arsenic for several hundred years. Recent evaluations of the concentrations of arsenic and iron in the pond sediments (Table F.1 – F.4, NAS, pp 96-99) confirm high iron content in the sediments that can continue to adsorb additional arsenic above the measured concentrations for many years. In addition, the input of suspended solids (TSS) with natural iron containing minerals to the HBHA Pond via Hall's Brook and other waters during normal and high flow events continue to provide additional adsorption sites and arsenic removal capacity.

That is, the suspended solids in the surface waters settle in the HBHA Pond creating more iron rich sediments in the bottom of the pond. Bypassing Halls Brook during storm events will remove an important source of iron-rich sediments.

Removal of sediments from the HBHA Pond, as proposed in USEPA's Proposed Plan, will destroy an effective and important arsenic removal process and is not necessary to prevent arsenic migration from the HBHA Pond. Existing pond sediments provide an important arsenic removal function that continues to be effective. This important function should not be destroyed by removing sediments. Since it is inappropriate and unnecessary to remove sediments from HBHA Pond, installation of a liner in the New Boston Street Drainway to prevent migration of arsenic-containing sediments to the Pond is not necessary. Lining the Drainway will cut off a source of iron-containing minerals which are critical to continued arsenic removal in HBHA Pond.

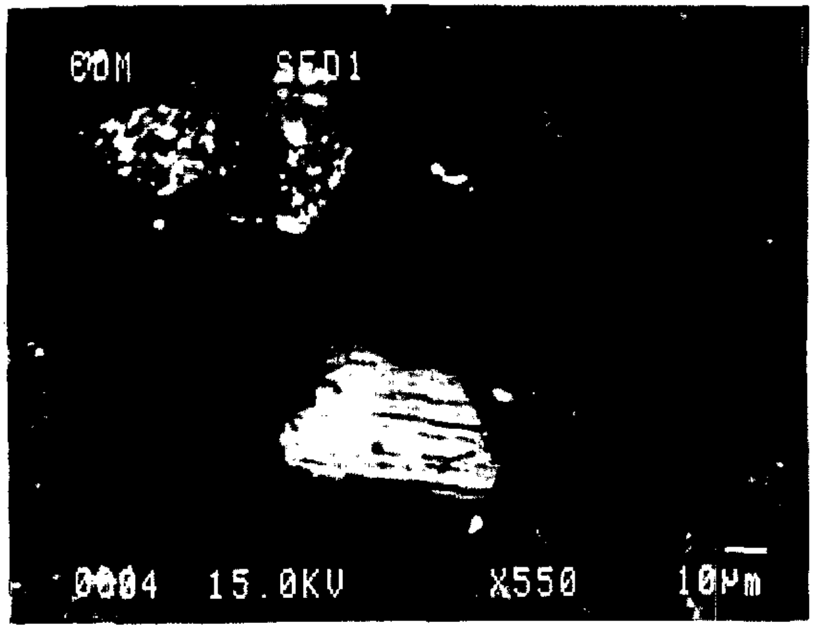
3.3 References

CDM, Envirogen, ES & E and Roux Associates, September 1997. Supplemental Site Investigation Report, Industri-Plex Site, Woburn, Massachusetts.

Ford, R. , September 2, 2004. Natural Attenuation Study, Industri-Plex Superfund Site,

USEPA, March 2005. Draft Final MSGRP Remediation Investigation Report, Industri-Plex Site, Woburn, Massachusetts

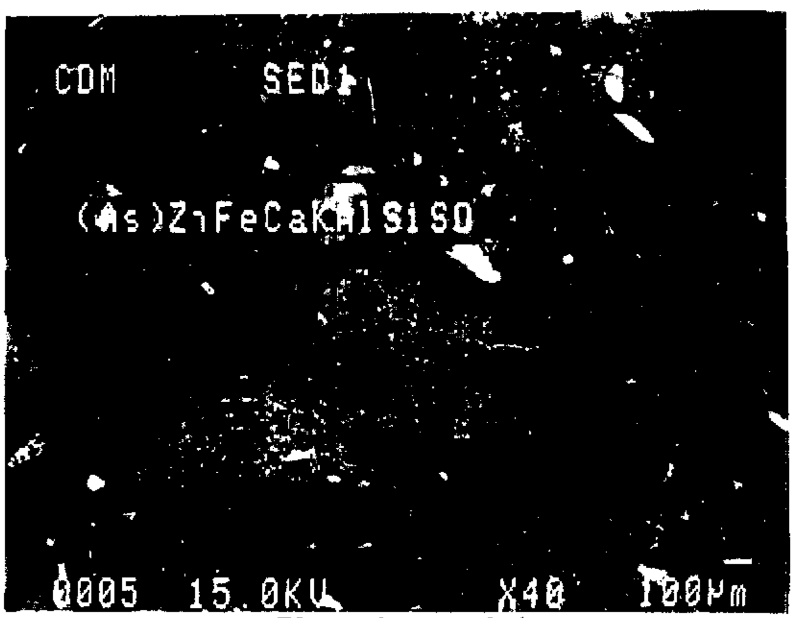
USEPA, June 2005. Draft Final Feasibility Study, Industry-Plex Site, Woburn, Massachusetts.



Photomicrograph 1
SED 1
Backscatter image showing a particle of iron/aluminum sulfate containing 6.4% arsenic and two grains of biotite containing approximately 0.2% arsenic.

Photomicrograph 2
SED 1
Arsenic concentration map (Dot map) showing the same frame as in photomicrograph 1. Note the higher density of dots on the iron/aluminum sulfate and biotite grains.

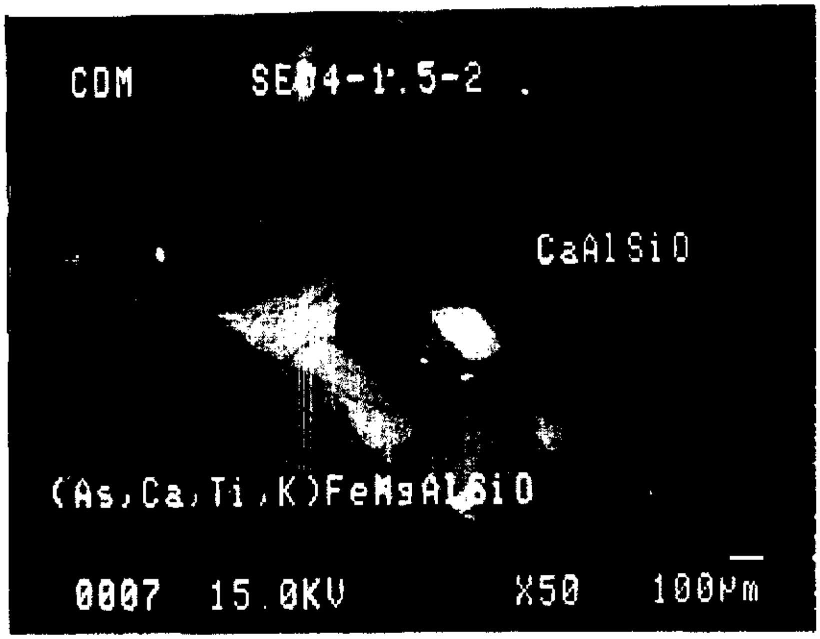
Photomicrograph 3
SED 1
Backscatter image showing a grain of iron/calcium/zinc sulfate containing 2% arsenic.



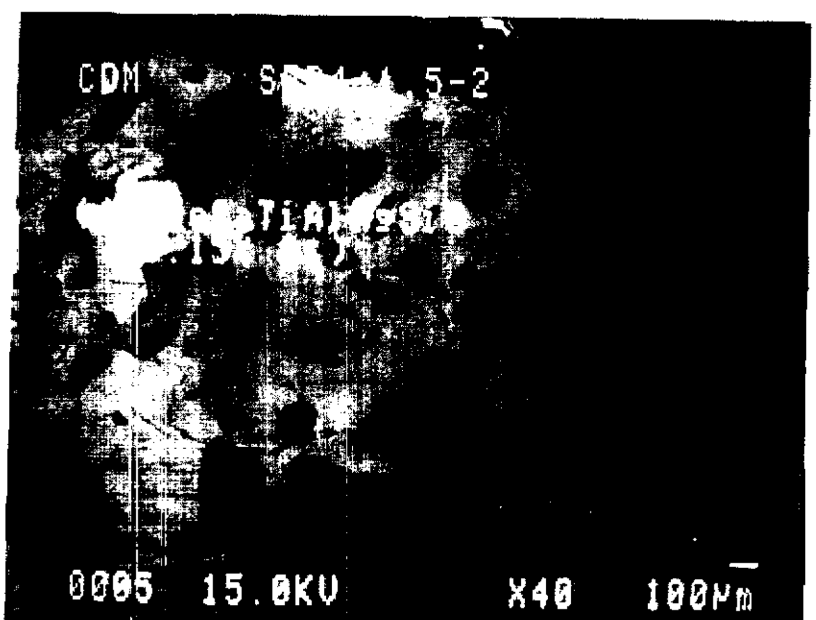
Photomicrograph 4
SED 1
Backscatter image showing a mass of alumino silicate and quartz grains cemented by an arsenic - bearing iron/calcium/zinc sulfate.

Photomicrograph 5
SED 4
Backscatter image showing a biotite or clay grain containing 0.07% arsenic.

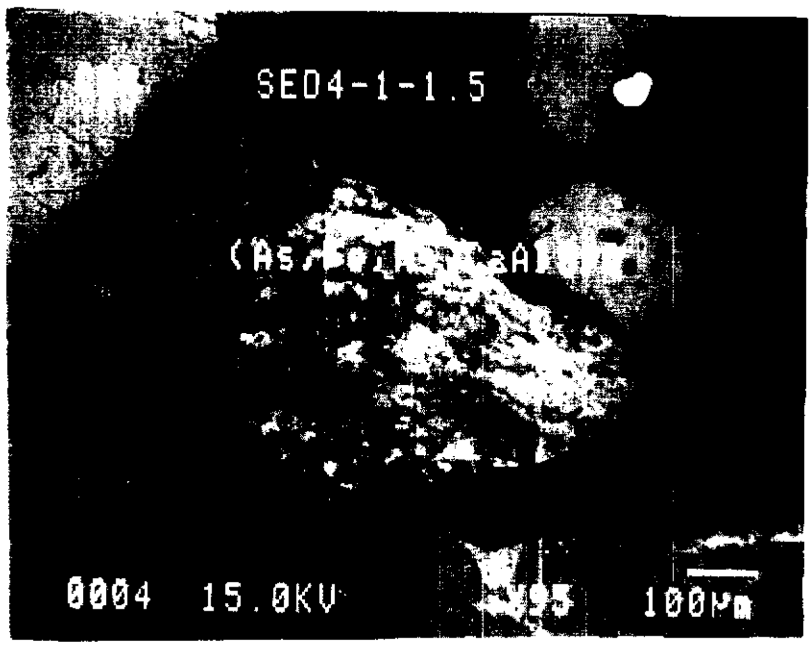
Photomicrograph 6
SED 4
Backscatter image showing arsenic bearing biotite grains intergrown with quartz.



Photomicrograph 7
SED 4
Backscatter image showing an arsenic-bearing biotite grain



Photomicrograph 8
SED 4
Backscatter image showing an amphibole or pyroxene grain containing 0.15% arsenic.



Photomicrograph 9
SED 4
Backscatter image showing an arsenic - bearing silicate mineral.

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Education

Ph.D. - Geochemistry, Colorado School of Mines (1979)

B.S. - Mineral Engineering Chemistry, Colorado School of Mines (1972)

Dr. Olsen has more than 29 years of experience in the conduct, planning, and management of comprehensive sampling programs for soils, sediments and water, treatability studies, implementation of quality control procedures, evaluation of risks/impacts, design/engineering of remediation systems, and remediation costs analysis. His experience includes evaluations on over 100 sites contaminated with metals/arsenic, 30 RCRA sites and remedial investigation/feasibility study (RI/FS) studies at more than 150 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites. Dr. Olsen is a recognized expert in the evaluation and modeling of chemicals in surface water, groundwater, soils, and sediments. Dr. Olsen is the author of over 120 publications or presentations including 10 on the fate, transport and treatment of arsenic. He has presented expert testimony in 20 cases concerning the fate/transport of inorganic and organic chemicals in the environment and evaluation/cost of remedial systems. Because of his broad experience and technical expertise, Dr. Olsen is routinely requested to assist in scoping and planning overall environmental strategies and remediation at sites.

In all, Dr. Olsen has performed evaluations at over 50 sites contaminated with arsenic. Problems evaluated included: bench scale tests to remove arsenic from water to below detection limits using activated alumina; evaluation of fate/transport of arsenic in water and soil using column tests; determination of absorption and desorption properties of arsenic on soils/sediments; bench scale tests for solidification of arsenic in soils and wastes; removal of arsenic from groundwater using air stripping; determination of the form/species of arsenic in soils; determination of the bioavailability of arsenic in soil; evaluations of solid iron containing media (including ZVI) to remove arsenic *in situ;* use of natural attenuation mechanisms to remove arsenic in groundwater; and reprocessing studies to remove lead and arsenic from wastes. Dr. Olsen has also evaluated the use of air stripping, addition of iron salts and use of adsorption media to treat arsenic in groundwater and landfill lechate. Dr. Olsen helped pioneered techniques to determine the sources of lead and arsenic in soil using speciation techniques including electronmicroprobe. Dr. Olsen has also used electron microprobe techniques to evaluate the removal mechanisms of arsenic from groundwater using natural iron containing minerals. He has performed batch tests to quantify adsorption properties and capacity (isotherms) of arsenic on natural iron containing minerals and precipitated iron hydroxides (HFOs). Based on these evaluations, Dr. Olsen has helped design both *in situ* and *ex situ* treatment systems for arsenic in groundwater and surface waters.

Examples of Dr. Olsen's recognition as an expert in the area of strategic planning is the variety of committees and projects he works on. Some of these include:

- National Research Council's Committee on Innovation in and Commercialization of Ground Water Remediation. Dr. Olsen is currently completing this 3-year appointment. He was subchairman of the section on testing and methodology for innovative systems.

- Presumptive Remedy for Metals in Soils. Dr. Olsen was selected by EPA to review and write sections of the new Presumptive Remedy for Metals in Soils. The draft of this guidance is under review.

- Protocol for Implementing Intrinsic Remediation. Dr. Olsen was one of three experts selected by EPA to review the draft document: "Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Ground Water" issued by the Air Force.

- Dr. Olsen was an Invited speaker at U.S. EPA's Workshop on Managing Arsenic Risks to the Environment: Characterization of Waste, Chemistry and Treatment and Disposal.

Dr. Olsen has also recently received awards for his projects. These include:

- American Academy of Environmental Engineers' Superior Achievement Award (top prize) for the Wichita Area Treatment, Education and Remediation (WATER) Center (treatment/reuse of contaminated groundwater)

- American Academy of Environmental Engineers' Grand Prize in the Planning Category for Innovative Approaches at the Gilbert-Mosley Site

- American Academy of Environmental Engineers' Grand Prize in the Design Category for the Brooks Landfill Air Sparge System

- American Consulting Engineer's Council National Honor Award for Passive Treatment of Acid-Mine Drainage

- American Consulting Engineer's Council National Honor Award for the WATER Center

- American Consulting Engineers' Council National Honor Award for Bioremediation Pilot Plant

- American Academy of Environmental Engineers' Grand Prize in the Research and Development Category for Bioremediation Pilot Plant

- Civilian Research and Development Foundation Award for Best Project and Project Contributing to the Overall Improvement of Mankind (one of eight selected)

Dr. Olsen is also skilled in the application of state-of-the-art chemical transport models to assess ground water impacts of hazardous waste disposal. He has applied these models on 50 migration assessments. Dr. Olsen is the author (or co-author) of over 120 publications/presentations. He has recently co-authored papers on the adsorption behavior of arsenic, desorption characteristics of TCE, the geochemistry and treatment of chromium, speciation of lead in soils and identification of PRPs, metal distribution in streams, and comparison of methods to analyze metals in surface waters. Dr. Olsen has presented expert testimony in 20 cases on the fate and transport of inorganic and organic chemicals in the environment and the evaluation/cost of remedial technologies.

Presentations/Publications - Roger L. Olsen

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4.0 Comments on USEPA's Proposed Plan for Surface Water

USEPA's Proposed Plan for sediments in Halls Brook Holding Area is fatally flawed and should not be selected for implementation because:

- **HBHA Pond and Wetland are effectively controlling downgradient transport of arsenic. USEPA's Proposed Plan would alter the entire hydraulic regime of the HBHA system, resulting in the loss of important flood mitigation functions and arsenic sequestration and attenuation processes;**
- **Installation of Coffer dams in HBHA Pond will adversely affect arsenic removal by reducing the settling capacity of HBHA and thereby decrease its ability to precipitate and sequester arsenic as groundwater discharges to surface water;**
- **Unmitigated flows from the Atlantic Avenue Drainway and the ephemeral stream draining NStar Right of Way (ROW) No. 9 could re-suspend and flush precipitated and sequestered arsenic from the sediment retention cell created by installation of the cofferdams across HBHA Pond. Unlike now, sediments flushed from the sediment retention cell would be transported downstream to HBHA Pond, kept in suspension by the Halls Brook stormwater bypass and transported downstream to HBHA Wetland and the Aberjona River;**
- **Low density hydroxide floc and adsorbed arsenic in the Sediment Retention Cell will be re-introduced into the water column during spring and fall turnover and transported downgradient to HBHA Pond and Wetland areas by storm events;**
- **Installation of a stormwater bypass structure at the confluence of Halls Brook with HBHA Pond would eliminate delivery of iron-rich sediments to the sediment retention cell created by installation of the Coffer dams across HBHA Pond and decrease the Pond's effectiveness in precipitating and sequestering arsenic;**
- **Installation of Coffer dams in HBHA Pond, in conjunction with the stormwater bypass of Halls Brook, will significantly alter the current hydrologic regime of Halls Brook Holding Area, which is effectively attenuating 100-year runoff velocities and volumes, and potentially exacerbate upstream flooding in the Atlantic Avenue Drainway and adversely affect downstream flood control in the Aberjona River.**

4.1 HBHA Effectively Controls Downgradient Transport of Arsenic

The finding of the Multiple Source Groundwater Response Plan (MSGRP) RI/FS acknowledged that the current HBHA system is attenuating and sequestrating arsenic entering the Pond via ground water inflow. The present level of performance is largely attributable to the unique hydrogeochemical features currently operating in the system. The depositional environment created and maintained by the long length to width ratio of the Pond in conjunction with the velocity mitigating effects of the Ponds bathymetry and flat hydraulic grade are collectively responsible for the arsenic sequestration performance evidenced in the Pond to-date. These unique features, in combination with the velocity mitigation, storage and depositional environment provided by the downgradient Wetlands have collectively functioned to minimize the downstream transport of arsenic from the HBHA system.

USEPA's Proposed Plan would partition the Pond into hydraulically isolated basins and divert Halls Brook stormwater inflows to a Southern Pond Basin. As discussed in the following sections, this in effect would alter the entire hydraulic regime of the HBHA system resulting in the loss of important flood mitigation functions and arsenic attenuation potentials. For these two reasons alone, the USEPA's Proposed Plan is ill-advised and should not be implemented as designed.

4.2 Pond Partitioning Will Adversely Effect Arsenic Removal

The HBHA was designed as a flood mitigation system. However, the flat hydraulic grade and Pond/Wetland sequence have created an excellent environment for sediment deposition and arsenic sequestration. This is evidenced by the accumulation of approximately 14,000 cubic yards of sediments since its initial construction in the early 1970s. The bathtub-like bathymetry of the Pond in conjunction with its long length to width ration (i.e., 7:1) provide the hydraulic retention time needed to settle both course and fine grained sediments from the water column (Schueler, 1992, Horner, 1990, Yousef et al. 1986, 1991). Sediment depositional bathymetry was delineated during the Groundwater/Surface Water Investigation Plan (GSIP) investigation. Findings reflect a relatively uniform deposition pattern along the axis of the Pond (Roux Associates, 2002). This is largely attributable to the points of tributary inflow to the Pond, differential-settling velocities of sediments of varying compositions and densities, and importantly, the hydraulic features displayed by the Pond under extreme runoff conditions. Geotechnical data indicate that the finer low-density sediments are accumulating near the outlet of the Pond, with coarser sediments settling immediately downgradient of tributary inflow points. While some sediment mounding is observed at these locations, interim natural forces are periodically redistributing these sediments across the Pond bottom (Roux Associates, 2002)

The installation of the proposed Coffer dams across the Pond would partition the Pond into two retention basins (i.e., North (Sediment Retention Cell) and South Basin), with each basin displaying new hydraulic and depositional features. The new North Basin (Sediment Retention Cell) would display a length to width ratio of approximately 2:1 and the remainder of the Pond would have a 3:1 ratio. Under stormflow conditions, the proposed reduction in length to width ratios could significantly affect the settling capacity of fine grained sediments thereby increasing sediment delivery to downstream areas (Horner, 1990). An evaluation of sediment transport was not performed as part of the MSGRP RI/FS. Thus, the effects of the proposed remedy on sediment deposition, re-entrainment and transport to downstream areas remain undefined. Given the acknowledged association between Total Suspended Solids (TSS) and arsenic export from the Pond, the omission of sediment transport analyses precludes any credible projection of remedy performance.

4.3 Storms Will Flush Sediments from Sediment Retention Cell

The approximate 11-acre HBHA system was designed to mitigate flood flows from storms of up to 100-year recurrence frequency. This is evidenced by the flat hydraulic grade (0.0054%) and low peak velocities reported int eh 1980 FEMA Flood Insurance Study Report (FEMA, 1980). The storage and buffering capacity of the Pond and contiguous Wetlands system, in conjunction with a flat hydraulic grade, has effectively mitigated runoff events of various size and duration. However, interim land use changes within the HBHA's contributing watershed have increased peak runoff rates and volumes thus affecting the hydraulic performance of the system (VSB, 2003). As discussed below, the arsenic mitigation strategy incorporated in the USEPA's Proposed Plan will likely be subject to periodic up-set and flushing via stormwater inflows from the Atlantic Avenue Drainway and the NStar ROW No. 9 drainage culvert. Similarly, re-suspended hydroxide floc transported to the Southern Basin will be flushed downstream by flows from the Halls Brook bypass. The intensity of these flushing flows will increase as development within the Pond's contributing drainage basin increases. Consequently, USEPA's Proposed Plan will remain susceptible to periodic flushing events and hence will continue to export sediment from the HBHA system. For this reason, USEPA's Proposed Plan is ill-advised and should not be implemented.

The new North Basin (Sediment Retention Cell) will be subjected to direct inflows from the Atlantic Avenue Drainway and the ephemeral stream draining NStar ROW No. 9. Collectively, these two inflow points drain approximately 45 percent of the area discharging to the Pond (MSGRP RI, 2005). During major storm events, runoff entering the basin from these sources will be significant and unmitigated. As evidenced by runoff hydrographs generated from the 5.31-inch precipitation event that occurred on March 22-24, 2001, peak inflows from the Atlantic Avenue Drainway approached 90 cubic feet per second (cfs), while the NStar ROW No. 9 culvert peaked at over 20 cfs (Roux Associates, 2002). The 5.31-inch event, while significant, corresponded to a design storm with a recurrent frequency of only 10 years (NCRS, 1986). Peak inflows from a 100-year event would be substantially greater. Ultimately, the flushing effects associated with large design storms would significantly and adversely affect the performance of the USEPA's Proposed Plan .

4.4 Downstream Transport of Low-Density Hydroxide Floc

Arsenic-containing iron hydroxide floc will form when reduced water in the bottom of the Sediment Retention Cell encounters the oxic/anoxic transition zone. Hydrous ferric oxides will form at the oxic/anoxic transition zone as reduced ferrous (Fe^{+2}) iron encounters oxygenated water, oxidizes to ferric Fe^{+3}) iron and precipitates as hydrous ferric oxide (HFO) floc (Skousen and Ziemkiewicz, 1995). Arsenic sorbs to the HFO floc, which would accumulate in the bottom of the Sediment Retention Cell.

Flushing flows into the Sediment Retention Cell from the Atlantic Avenue Drainway (90 cfs) and the ephemeral stream draining NStar ROW No. 9 (20 cfs) during major storm events would likely disrupt the chemocline and flush arsenic-bearing HFO floc to downgradient locations. The shortened length to width ratios created by the partitioning Coffer dams and the bypass of Halls Brook would significantly reduce TSS settling efficiency in the Southern Basin thereby increasing the export of the low density floc materials to downstream locations. The length to width ratios will shorten the amount of time and distance fine grained sediments will have to effectively settle out of the water columns. Similarly, the loss of the Northern pond area to Halls Brook inflows during stormwater runoff periods will eliminate the hydraulic buffering capacity, shorten available sediment settling time and convey higher sediment loads directly to the pond outlet from a re-directed Halls Brook (i.e., the by –pass option).

Perhaps more importantly, storms of lesser intensity occurring immediately after spring and fall turnover would export the re-entrained floc to the South Basin and similarly transport the arsenic bearing TSS downstream via the mechanisms discussed above. Turnover occurs in lakes and ponds deep enough to thermally stratify. In essence, as water cools in the fall, density differentials in the water column cause the cooler surface water to sink displacing warmer bottom water. This "turnover effect" results in a completely mixed water column that reintroduces low-density sediments present in the bottom of the Pond uniformly throughout the water column. The water will thermally re-stratify during the colder winter periods. During late winter ice-out conditions, the surface water warms to maximum density (i.e. 4°C), subsequently sinks to the bottom resulting in a spring turnover event. Similar complete water column mixing occurs until thermal stratification is re-established and water column stability returns (Wetzel, 1975, Tchobanogious and Schroeder, 1987). Even in the event that some of this material is re-deposited in the South Basin, it would be subject to re-entrainment and flushing during storm events via the high velocity inflows from the Halls Brook bypass option.

For these reasons, USEPA's Proposed Plan is ill-conceived and ill-advised.

4.4 Halls Brook Bypass Will Negatively Impact Arsenic Removal

A significant flaw in USEPA's Proposed Plan is the loss of future iron-rich sediment delivery to the proposed North Basin (Sediment Retention Cell). The elimination of the continuous supply of iron-rich organic materials from Halls Brook inflows during storm events could adversely impact the arsenic sequestration and attenuation processes in the Sediment Retention Cell. The potential effects of removing this source of iron on the long-term performance of the proposed remedy was neither evaluated nor discussed in the MSGRP Feasibility Study. For this reason, USEPA's Proposed Plan should not be implemented.

Another negative effect of the proposed Halls Brook stormwater bypass would be the elimination of a continuously oxygenated water supply to the proposed Sediment Retention Basin. As the sole perennial stream entering the Pond, Halls Brook is the major source of dissolved oxygen delivery to the water body. Given the importance of maintaining aerobic conditions in the Sediment Retention Cell for arsenic removal, the proposed bypass of stormwater inflows to the southern basin of the Pond could significantly effect the long-term maintenance of aerobic conditions within the proposed basin. Ultimately, this could result in the periodic development of anaerobic conditions within the basin and significantly effect arsenic removal performance. An evaluation of the oxygen demand needed to sustain the proposed system and the subsequent effects of removing a major oxygen supply source (i.e., Halls Brook) were not addressed in the USEPA's Proposed Plan evaluation.

4.5 Flooding Effects Not Evaluated

USEPA's Proposed Plan includes the installation of Coffer dams at two locations in the northern portion of the HBHA Pond. The Proposed Plan also includes the bypass of Halls Brook downgradient of the dams. Placement of the Coffer dams as proposed would hydraulically isolate approximately 40 percent of the Pond area from Halls Brook inflows. The resultant retention basin created north of the dams would be subject to surface water inflows from the Atlantic Avenue Drainway and from a culvert draining the business park area located east and slightly north of the Pond. An evaluation of potential upstream flooding effects created by the proposed dams and the potential downstream flooding effects created by the proposed bypass of Halls Brook was apparently omitted from the MSGRP Remedial Investigation and Feasibility Study. Given the history of serious flooding in the Cities of Woburn and downstream Winchester, and the fact that the HBHA system was designed exclusively for flood mitigation purposes, the omission of an evaluation of flooding-related impacts of USEPA's Proposed Plan constitutes a serious flaw that should preclude selection and implementation of this plan.

The HBHA Pond and Wetland system was constructed in the early 1970s as a flood control project to replace the filled-in Mishawum Lake. As stated in the RI, the HBHA was designed as a flood control project. The hydraulic design of the system results in very low flow velocities (i.e. from 0.1 to 0.3 feet per second) for storms of up to 100-year recurrence frequency (FEMA, 1978). Very low flow velocities during storm conditions are due to the bathtub-like design of the Pond (long and narrow with steep sides and a high inlet and outlet), the flat hydraulic grade of the Wetlands, and flow restrictions at the Mishawum Road outlet. Collectively, these features have limited "flushing flow" events to storms of significantly greater magnitude then a 100-year storm, and have established and maintained a stable depositional environment in both the Wetlands and Pond.

Flooding along Halls Brook and the Aberjona River prompted the completion of two recent studies by the US Army Corps of Engineers (USACE) and the Federal Emergency Management Agency (FEMA). The first study, commissioned by the ACOE, evaluated hydrologic/hydraulic conditions along the Middlesex Canal and Halls Brook. The study was performed by Vanasse Hangen Brustlin, Inc. (VHB) in 2003. Applicable findings reported an increase in 100-year peak discharges to the HBHA Pond from Halls Brook of from 420 cfs (FEMA, 1978) to 1,120 cfs (VHB, 2003). This significant increase in peak Pond inflow rates is attributed to "recent development in the study area" and possibly "substantial flows coming from the industrial area in Wilmington" entering Halls Brook at the Boston and Maine Railroad. The velocity of Halls Brook at the point of Pond discharge was not provided although the 1978 FEMA Study lists this at 7.1 feet per second (fps). This high velocity is currently mitigated by the Pond as evidenced by the 0.3

fps velocity reported for the Pond outlet during 100-year runoff conditions.

USEPA has failed to evaluate outlet velocities that would result from its Proposed Plan. The loss of 40 percent of the Pond area through installation of the proposed Coffer dams in conjunction with the proposed Halls Brook bypass remedy will significantly lessen the velocity mitigating effects of the Pond during design storm runoff conditions. Higher velocities would result in scouring, entrainment and transport of Pond sediments to downgradient locations. USEPA's Proposed Plan would also result in the loss of 40 percent of the Pond's storage capacity thereby increasing the likelihood of downstream flooding.

A second study of flooding conditions along the Aberjona River was commissioned by FEMA and performed by ENSR International, Inc. to update the 1978 FEMA Flood Insurance Study (FIS). The study was initiated in 2002 and is still underway. Extensive hydraulic and hydrologic modeling of Halls Brook and the Aberjona River were performed as part of the study. Preliminary results indicate a 0.57-foot increase in the 100-year Base Flood Elevation (BFE) at the Mishawum Road outlet (ENSR, personal communication, 2005). The corresponding increase for a 500-year storm is reported at 1.85 feet. These increases represent the effects of development in the HBHA contributing watershed since completion of the 1978 FEMA Study and clearly indicate that HBHA is handling higher flows than it was originally designed for.

Flooding is a major concern of the local communities. Given these higher flows and the frequency and impacts of downstream flooding, any proposed remedy that would alter the hydraulic performance of a flood control system like the HBHA should be subjected to extensive hydraulic analyses to ensure that USEPA's Proposed Plan does not exacerbate flooding in the future. In discussions with local USACE and FEMA representatives responsible for the two flood-related studies identified above, both groups acknowledged that they were not contacted by the USEPA or its designated consultant (TetraTech NUS, Inc.) to discuss potential flooding associated with implementation of the Agency's Proposed Plan (William Mullen, USACE, personal communication, 2005; Mark Otis, USACE, personal communication, 2005;; Jim Herberich, ENSR, personal communication, 2005). The absence of a flood-impact analysis for the Proposed Plan constitutes a fatal flaw because it does not ensure that downstream communities will not be subjected to greater flooding.

The preceding discussion underscores the design and performance uncertainties associated with the USEPA's Plan as proposed. The installation of the Coffer dams across the Pond will certainly reduce the length to width ratios resulting in reduced sediment settling efficiencies. The Halls Brook bypass will similarly reduce iron-bearing sediment delivery to the North Retention Basin, reduce the delivery of oxygen bearing water to the North Basin, exacerbate downstream flooding potentials through the loss of approximately 40 percent of the Pond's storage volume and increase the export of potentially arsenic-bearing sediments to downstream locations. Collectively, these flaws preclude the viability of the USEPA's Proposed Plan.

4.6 References

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Walter H. Eifert
Principal Hydrologist

Technical Specialties:
Applications of and constructed treatment wetlands (CTW) and phytoremediation technologies for the treatment of ground water, stormwater runoff, municipal and industrial wastewaters and non-point source pollution. Watershed Management including surface water and wetland mitigation/restoration, ecological assessments, lake and stream remediation, surface water modeling and flood plain investigations.

Experience Summary:
23 years of experience: Principal Hydrologist at Roux Associates; Senior Scientist/Project Manager at BBI Environmental; Senior Scientist/Manager of Water Quality at York Services Corporation; Water Resources Planner/Project Manager at E. A. Hickok and Associates; and Research Associate at the Wyoming Water Research Center, University of Wyoming.

Credentials:
M.S. Water Resources Management, 1982
B.S. Aquatic Biology, 1980

Professional Affiliations:
American Water Resources Association
Society of Wetland Scientists
Water Environment Federation
Interstate Technology Regulatory Cooperation (ITRC)
Gamma Sigma Delta, Agricultural Honorary
Sigma Xi, Research Honorary

U.S. Patent
U.S. Patent Awarded on April 13, 1999
Enhanced Sub-Surface Flow Constructed Wetlands
Patent No. 5,893,975

Key Projects:

Watershed Management

- Presently the surface water hydrologist for the Industri-Plex Site Remedial Trust (ISRT), Woburn, MA. Services provided to-date have included the preparation of sediment fate and transport elements of the GSIP Work Plan, the completion of a conceptual design and cost analysis for an enhanced sediment retention facility in the Hall's Brook Holding Area and participation in meetings with the Agency.
- Completed a conceptual design and cost analysis of an enhanced sediment retention/treatment system for the Industri-Plex Site, Woburn, MA. The design consisted of retrofitting a CTW/Phytoremediation system into the Halls Brook Holding Area (HBHA) pond and wetlands. The functional objective was to reduce sediment export from the Site by 85%. The project was completed for the ISRT in March 1998. Implementation is currently pending the completion of a detailed sediment fate and transport investigation.
- Completed a watershed management needs analysis in support of a 27-hole golf course development project proposed at a 700-acre inactive industrial Site in eastern Virginia. The analysis included completion of watershed runoff modeling, buffer zone determinations, integrated pesticide management programs, irrigation needs and water quality management. The study recommended use of wastewater re-use to minimize water supply and treatment costs and to provided passive capture and treatment of stormwater runoff.
- Project Manager for the Minnesota River Study, a Twin Cities Metropolitan Waste Control Commission Project involving the identification of feasible alternatives to improve receiving water quality in lieu of constructing advanced wastewater treatment facilities. The project resulted in the identification of an alternative that would be protective of in-stream water quality criteria and provide over $20,000,000 in savings to the Commission.
- Performed an extensive surface water modeling analysis of the 183 square mile Minnehaha Creek Watershed, Minneapolis, Minnesota. The project was completed as part of a $400,000 Watershed Management Plan prepared for the Minnehaha Creek Watershed District. The modeling analysis was performed using the USCOE HEC-1 and HEC-2 software programs. Activities included model calibration and simulation of runoff from a series of design storms. Modeling results were used to quantify storage requirements and floodplain management needs in the watershed and were subsequently used to develop capital improvement recommendations for the District.
- Performed TR-55 runoff modeling for numerous projects in MN, WV, VA, MA, PA and NY. The modeling is routinely conducted to quantify pre- and post-development changes in runoff hydrographs associated with design storms of 2, 5, 10, 25, 50 and 100-year return frequencies. The TR-55 software was developed by the U.S. Soil Conservation Service and is widely used in small-scale hydrologic investigations.
- Performed a hydrologic evaluation along a reach of the Coeur D'Alene River adjacent to the Bunker Hill Superfund Site, Kellogg, Idaho. The project was conducted in support of a Master Remediation Plan developed for the Site. Hydraulic characteristics of the study reach were evaluated through the completion of a computer modeling analysis using the HEC-2 Water Surface Profile program developed by the ACOE. Modeling results served as the basis to develop 100-year flood profiles through the study reach. The project was completed for Site PRPs with the results used to support planned remediation activities at the Site.
- Project Manager for the design and completion of a sediment fate and transport analysis at a large coal mine in central Wyoming. The project was conducted to identify alternative sediment control measures at the Site. SEDIMOT II modeling served as the basis to quantify sediment fate and transport dynamics and evaluate potentially viable alternatives. The project was performed for the Office of Surface Mining, Denver Colorado.
- Project Manager for the completion of the McLeod County Landfill post-encroachment floodplain analysis, McLeod County, Minnesota. The project was conducted to identify encroachment limits for a proposed landfill expansion into the 100-year floodplain of the Crow River. Simulation analyses using the ACOE's HEC-2 software were used to identify allowable limits. The modeled encroachment was approved by the Minnesota DNR and FEMA. The modeled results were within 0.01inches of a 100-year runoff event that occurred at the Site the following year.
- Completed numerous hydrologic and floodplain investigations in support of Site remediation projects and stormwater permitting activities. Examples of applicable projects include a focused hydrologic investigation to quantify base flow discharge rates and volumes at an industrial site in New York; a hydrologic/natural attenuation

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Principal Hydrologist/National Client Manager

investigation at the OTT/Story/Cordova Superfund Site in Muskegon, Michigan; a floodplain simulation analyses of Shingle Creek, a highly developed tributary of the Mississippi River near Minneapolis, MN; stormwater runoff investigations at two E.I. DuPont De Nemours Plants located in Dunbar, PA and Falling Waters, WV; hydraulic/treatment needs analyses for two large aluminum reduction facilities located in Frederick, MD and Ravenswood, WV; and a hydrological water quality investigation at a major incineration facility located in New York City. The investigations included the design and implementation of hydrologic and water quality monitoring programs, data interpretation and report generation.

- Designed, managed and completed several hydrologic investigations using dye dilution techniques. The studies included time-of-travel investigations, discharge calculations, and hydrograph development and routings. Example projects included a surface water/ground-water interaction study completed for the USGS in southeastern Wyoming; a time-of-travel investigation along a 3-mile reach of the Runnins River in RI; a surface water runoff analysis at an industrial site in VA and a combined sewer overflow assessment at a large steel manufacturing facility in western PA.
- Designated expert witness as a hydrologist in a property damage lawsuit attributable to flooding. Litigation support activities have included a review and assessment of the subject property and the preparation and submission of a technical evaluation report. The case was settled out of court prior to trial. The subject site was located in Houston, Texas.

Aquatic and Terrestrial Ecology

- Project Manager for the preparation of a detailed watershed management plan for the Minnehaha Creek Watershed District, Minneapolis, MN. Tasks included completion of a comprehensive physical, chemical and biological inventory of the 183 square mile watershed, computer simulation analyses of the hydrologic and water quality response under a variety of design storm conditions, and the development of a capital improvements program and implementation schedule.
- Project Manager for the Living Lakes Program, a six-year multi-million dollar project to develop and demonstrate cost-effective technologies for the neutralization of acidic surface waters and the restoration of important fisheries. The project included the intensive field sampling of fish, benthic macroinvertebrates and zooplankton communities in 39 lakes and 13 streams located in the northeastern, mid-Atlantic and upper Midwest regions of the U.S. Results were used to develop guideline criteria for lake and stream restoration projects.
- Completed a field investigation and evaluation of three aquatic habitat assessment procedures widely used in in-stream flow investigations. The project included the extensive analysis of benthic macroinvertebrate community abundance and diversity, seasonal effects of varying hydrologic flow regimes, temporal variations in in-situ water quality and an assessment of the population dynamics of indigenous fish communities. The project resulted in the preparation of an ocular habitat assessment tool designed to facilitate and expedite preliminary in-stream flow field investigations. The project was completed for the Wyoming Water Research Center of the University of Wyoming.
- Project Manager for the completion of the Long Lake Chain of Lakes restoration project. The principal objective of this USEPA Phase II restoration project included implementation of a series of hydrologic and water quality improvement elements collectively designed to reduce non-point source pollutant entry into the lake complex, improve in-lake water quality conditions and re-establish viable recreational fisheries in the seven lakes comprising the chain. The project was completed for the Rice Creek Watershed District and Minnesota Pollution Control Agency through funding provided by a USEPA Clean Lakes grant.
- Project Manager for the completion of the Moore Lake restoration project, a USEPA Phase II Clean Lakes project designed to restore recreational fisheries and improve water quality to a metropolitan lake impaired by non-point source pollution. Key restoration elements included the installation of a hypolimnetic aerator to oxygenated bottom water, placement of 6 acres of liner on the lake bottom to reduce sediment oxygen demand and the installation of a Biologically Activated Soil Filtration Unit (BASFU) to reduce pollutant loadings in stormwater runoff. The project was jointly completed for the city of Fridley, Minnesota and the Minnesota Pollution Control Agency.
- Managed and completed a preliminary water quality and fisheries study for Summit Lake, a high priority recreational resource located in Greenbriar County, WV. The principal study objectives included completion of a baseline evaluation of tributary and in-situ water quality and resident biological communities. Study results provided the framework for the preparation of a USEPA Clean Lakes grant application. The project was jointly sponsored by the West Virginia Department of Natural Resources and the Monongahela National Forest.
- Project Manager for the completion of a Phase I diagnostic feasibility study on Big Kandiyoki Lake near Willmar, Minnesota. The principal objectives of the project included the collection and analysis of in-lake physical, chemical and biological data, problem diagnosis and the development of feasible lake restoration alternatives. The overall goal was to improve in-situ water quality and re-establish viable biological communities. The project was jointly completed for Big Kandiyoki County, the Minnesota Pollution Control Agency and USEPA Region V.
- Project Manager for the completion of the Prior Lake/Spring Lake restoration project. Key project objectives included completion of a USEPA Phase I Diagnostic/Feasibility investigation and the restoration of water quality and recreational fisheries to both project lakes. The project included the extensive collection and analysis of water quality, fisheries, benthic macroinvertebrates, zooplankton and phytoplankton data. The project was jointly completed for the Spring Lake/Prior Lake Watershed District, Minnesota Pollution Control Agency and USEPA Region V.
- Completed physical, chemical and biological assessments of 63 miles of streams located in the Monongahela National Forest, West Virginia. The survey was conducted to evaluate the existing biological conditions of impacted streams and to develop remedial recommendations to facilitate biological recovery. The project was completed for the U.S. Forest Service, Elkins, West Virginia.

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- Designed, managed and completed a natural resources data assessment of Yellowstone National Park, Wyoming. The principal objective of the project was to obtain, review and critique ecological studies completed for the Park. The project resulted in the development of a computerized data base containing over 10,000 citations of studies completed within the Park. The project was completed for the U.S. National Park Service, Gardner, Montana.
- Designed, managed and completed an ecological data assessment of the Big Horn Canyon National Recreation Area, Wyoming. The project resulted in the collection, analysis and computerization of approximately 4,000 literature articles on the Area. The work was performed for the U.S. National Park Service, Moran Junction, Wyoming.
- Evaluated the aquatic ecology of two blue ribbon trout streams in southeastern Wyoming. The study included assessments of fish population dynamics, benthic macroinvertebrate diversity and abundance, zooplankton migration, hydraulic stability and water quality characteristics. The study was performed for the U.S. Department of the Interior.
- Developed a lake restoration model that evaluated the morphemetric and chemical characteristics of an acidified lake and calculated the dosage of neutralization agents. The model included an economic subroutine to evaluate design costs. The work was performed for the Edison Electric Institute, Washington, D.C.
- Designed and implemented an extensive wetlands monitoring program for a high value mixed hardwood swamp/emergent wetlands system adjacent to the Runnins River, East Providence, Rhode Island. The project included the development of a quantitative model to assess potential long-term ecological impacts to the wetlands from an extensive ground-water extraction system operating nearby. The project is scheduled for completion in late fall, 1998.
- Performed an ecological evaluation of a municipal solid waste landfill facility in Nicholas County, West Virginia. The evaluation was conducted in accordance with permitting requirements necessitated by a planned expansion of the landfill. The ecological resources evaluated included threatened and endangered species, terrestrial and aquatic habitats and vegetative communities. The findings were submitted to the West Virginia Division of Environmental Protection as part of the Permit application. An expansion permit was approved for the project.
- Completed preliminary ecological evaluations at a former fibers manufacturing facility in Williamsburg, Virginia. The assessments were conducted in a 70-acre headwater drainage/wetlands system in support of a leachate mitigation project being performed at the Site. Results of the assessments were reviewed and approved by the EPA, US-FWS, ACOE and Virginia DEQ as part of the permitting process. Federal, state and local permits have been issued for the project.

Wetlands

- Project Manager for the design of a 16-acre, 150,000 GPD CTW treatment system for the removal of heavy metals in diffuse leachate discharging from a 33-acre industrial waste landfill. The final design consisted of a staged treatment sequence containing passive pretreatment elements, a surface flow CTW treatment cell (aerobic), a subsurface flow CTW treatment cell (anaerobic) and a CTW polishing cell. Key features include entirely passive operation, metals precipitation in non-toxic sulfide forms and removal efficiencies to NPDES discharge standards or better. The system is projected to provide over $20 million in remediation/treatment cost savings. The system was constructed in the fall of 1998 and activated in January, 1999. Since that time, the system has consistently reduced zinc levels by greater than 99.9%.
- Project Manager for the design of a CTW system to treat landfill leachate at the Nicholas County Sanitary Landfill in Summersville, WV. The 25,000 GPD project included characterization and analysis of the leachate waste stream, system design, permitting and regulatory liaison. The facility was approved for construction by the WV Division of Environmental Protection (WV-DEP). An NPDES permit to discharge was issued by WV-DEP.
- Project Principal and lead designer of an enhanced natural treatment system at a new smelter facility under development in Iceland. Major treatment components of the system include grassed drainage swales, pocket CTW cells, two large terminal CTW units and hydraulically connected infiltration basins. The system is being designed to carry and treat runoff from a 20-year storm, and attain zero discharge for design storms of up to 25-year return frequencies.
- Designer of a 22,000 GPD municipal wastewater treatment system integrating CTW technology with conventional treatment methods. The design included use of several innovative features that resulted in a 50 percent reduction in CTW treatment area. The subsurface flow-type system serves a new 100-home subdivision and is designed to treat to tertiary standards. The system was constructed and activated in the summer of 1995. Performance to-date has been well within the facility's NPDES discharge limitations.
- Project Manager for design of a CTW treatment system to remove heavy metals at a large Superfund site in northern Idaho. The design included passive collection and treatment of an 8-cfs metals-laden wastewater stream. Target metals included zinc, lead, cadmium, iron and arsenic. The constructed wetlands alternative was approved for use in the ROD issued for the site.
- Project Manager for the design, permitting and construction of two municipal wastewater treatment systems using CTW treatment technology. The systems included a 3,000 GPD secondary facility located in Jefferson County, WV, and a 20,000 GPD facility constructed in nearby Morgan County, WV. The systems have been in operation since 1990 and 1992, respectively, and are operating in conformance with established NPDES discharge limitations.
- Project Manager for the design and evaluation of a pilot CTW treatability project at a large aluminum reduction/ manufacturing facility in central Maryland. The pilot system is designed to sequentially remove cyanide and fluoride in leachate collected from an on-site industrial waste landfill. Pre-design work elements included completion of a waste stream characterization analysis and preparation of a heavily annotated treatability white paper. The pilot-scale design contains several individually configured CTW treatment cells to evaluate and optimize contaminant removal potentials.

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- Project Manager for the design, installation and evaluation of a pilot-scale CTW treatment system at a major northeast petroleum terminal. The pilot system is designed to optimize the aerobic biodegradation of BTEX contaminants in shallow ground water. Key features include passive capture and in-situ treatment of the contaminated ground-water plume, sub-surface flow operation to minimize freezing, vector, odor and exposure concerns, and the installation of a passive nutrient addition chamber to enhance microbial growth and biodegradation efficiency. The system was installed in 1996 and is currently providing a BTEX removal efficiency greater than 95%.
- Inventor of two innovative CTW treatment system appurtenances designed to optimize system performance and reduce long-term treatment costs. Patent applications to the U.S. Patent office were submitted in February, 1997. A U.S. Patent (i.e., No. 5,893,975) was awarded in April, 1999.
- Project Manager for review and critique of the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989 Edition). The project was completed for the American Mining Congress, Washington, D.C.
- Project Manager for the design and construction of a CTW stormwater treatment system for a major eastern railroad corporation. The system included the passive treatment of oil and grease, metals and nutrients in a 3-acre subsurface flow type CTW treatment sequence. The system is sized to treat a hydraulic load of approximately 200,000 GPD. Coordinated completion of several jurisdictional wetlands studies in the States of NY, WI, MN, WV and RI.
- Project manager for the mitigation of impacted wetlands at a chemical Superfund Site in Wilmington, Delaware. The project involved completion of a functional assessment of the impacted wetlands, the identification of mitigation alternatives and the development and implementation of a cost effective mitigation plan jointly addressing both EPA mitigation requirements and NRDA claims. The plans involved the purchase and restoration of an off-Site wetland abutting a State wildlife area. Client responsibilities were limited to purchase of the marsh and a small compensatory contribution to facilitate the restoration. As restoration activities, long-term monitoring and maintenance were transferred to the State. Client savings were estimated at $1.5 million.
- Completed the delineation of an extensive intertidal freshwater wetlands at a large industrial site on Staten Island, NY. The 1998 delineation was field verified by the New York Department of Environmental Conservation and resulted in no changes to the original delineation performed by Roux Associates. The final negotiated boundaries reduced the extent of the originally defined wetlands complex thereby providing more land area for development.
- Completed a three-year evaluation of a protected intertidal wetlands complex at a petrochemical facility in Rhode Island. The evaluation included the initial delineation of wetland boundaries and quarterly field monitoring to assess potential impacts from nearby ground-water extraction wells. No impacts have been identified to-date. The project is scheduled for completion in early 1999.
- Project Manager for a CTW treatability investigation at a northeast Superfund site. The study investigated the potential use of CTW technology for the remediation of heavy metals, organics and conventional pollutants from Site ground water. Specific areas evaluated included contaminant removal mechanisms, retention efficiencies, constituent fate dynamics, bioavailability of processed contaminants, cost efficiency, life expectancy and preliminary design criteria. Results deemed the technology both technically and cost-effectively viable for use at the Site. Bench and pilot scale testing are presently pending.
- Project Manager for an investigation into the potential use of CTW technology to remove elemental phosphorus from ground water at a southeast industrial facility. The multi-phased project included completion of a wastestream characterization analysis, preparation of a treatability white paper, a mesocosm evaluation of processing mechanisms and implementation of a pilot-scale testing program. Results of the white paper supported potential applicability for use of the technology at the Site. Nine CTW mesocosm cells were constructed with several different types of substrates and emergent macrophytes.

<u>Phytoremediation</u>

- Project principal/designer of a Pilot Scale Enhanced Natural Systems project near Charleston, SC. Key project elements included the design of a 2-acre phytotechnology plot, constructed treatment wetlands system and vegetated filters to improve stormwater quality and reduce the volume of stormwater discharging from an active industrial Site. Supporting components included the evaluation of eight phytotechnology species in a greenhouse environment and the completion of extensive column testing experiments on various types of treatment media. The system was installed in late 2002 with startup planned for late spring, 2003.
- Completed the installation of 4,000 hybrid poplar trees (i.e., *Populus deltoides x nigra* DN-34) on the surface of an un-capped industrial waste landfill located on the Virginia Peninsula near Norfolk, Virginia. The principal objective is to evaluate use of the trees to consumptively utilize effluent released from an on-Site leachate treatment system. The 3-acre demonstration project will be expanded to include 34 acres of landfill surface if deemed successful. The trees were planted in the spring of 1999 and are presently being evaluated monthly. Full-scale implementation will result in a zero-discharge designation thus saving an estimated $250,000 in annual O&M expenses.
- Prepared and implemented a phytoremediation work plan to mitigate BTEX constituents and prevent the off-Site mitigation of contaminated ground water from an active chemical manufacturing facility in upstate, New Jersey. A total of 660 hybrid poplar trees were planted in barrier fashion at the apex of the ground-water plume and along the down-gradient boundary of the property. The trees were planted in the spring of 1999 and will be evaluated over a three-year maturation period. The project is anticipated to attain excellent in-situ treatment of BTEX constituents and prevent the off-Site migration of the ground water plume. Use of the technology at the Site was approved by state and federal regulatory agencies.
- Project Manager for the design and installation of 4,000 hybrid poplar trees at a major petrochemical transfer terminal located near Providence, Rhode Island. The principal objectives of the project include the in-situ

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treatment of BTEX constituents through rhizosphere bioremediation and the hydraulic containment (i.e., phytostabilization) of the ground-water plume discharging to a jurisdictional wetland. Work performed to date has included the completion of a soils characterization analysis, preliminary rooting tests in Site soils, the preparation of a detailed planting plan and the planting of 2,000 hybrid poplar trees. Planting activities were completed in April, 2000. The trees are presently established and growing well (greater than 95% survival). Quarterly performance evaluations are scheduled through 2004

- Project Manager for the design, installation and evaluation of a 4,000-tree phytostabilization project at an inactive industrial landfill Site near Detroit, Michigan. The design objective was to reduce leachate generation in two inactive industrial waste landfill cells located on the property. The phyto plantings (hybrid poplar trees) were initially installed in barrier fashion around and hydraulically upgradient of each cell in May, 1999. A phytotoxic agent in Site soils resulted in low initial transplant success. A phytotoxicity and rooting test investigation was conducted to identify, isolate, and mitigate the causative agents. The Site was replanted in April, 2000. A recent survival audit indicated greater than 97% of the trees have survived and or growing. Quarterly evaluations are scheduled to continue through tree maturation in 2004.
- Performed an initial assessment to determine the viability of using phytoremediation technology to mitigate PAHs in ground water at a former Manufactured Gas Plant (MGP) Site in New Hampshire. An additional objective was to evaluate potential use of the technology to hydraulically preclude the off-Site migration of ground water (phytostabilization). Work products included the preparation of a treatability "White Paper" and the preparation of a phytoremediation planting plan.

Litigation Support/Expert Witness

- Designated expert witness as a hydrologist in a property damage lawsuit attributable to flooding. Litigation support activities have included a review and assessment of the subject property and the preparation and submission of a technical evaluation report. The case was settled out of court prior to trial. The subject site was located in Houston, Texas.

5.0 Comments on USEPA's Proposed Plan for Sediments

5.1 Halls Brook Holding Area Pond Sediments

USEPA's Proposed Plan for sediments in Halls Brook Holding Area Pond should not be implemented for the following reasons:

- **Dredging is not an effective risk-reduction technology;**
- **The dredging alternative will not create a viable benthic organism habitat in HBHA Pond;**
- **Scouring during storm events is not re-suspending and transporting HBHA Pond sediments;**
- **USEPA significantly underestimated the volume of sediments in HBHA Pond.**

USEPA's Proposed Plan for the arsenic-impacted sediments in the Halls Brook Holding Area (HBHA) Pond (Alternative HBHA-4) includes, among other elements, dredging approximately 6,700 cubic yards of sediments from the southern end of the pond. The dredged sediments would then be dewatered and transported off-site for disposal. The northern portion of the pond is proposed by USEPA to be used as a sediment retention basin, and would need to be dredged periodically to remove accumulated sediment.

While dredging can be used to remove contaminated sediments, dredging the HBHA Pond is ill-advised for a variety of reasons. First, while dredging can remove sediment mass, it is not necessarily an effective technology when it comes to risk reduction; in fact, at a number of sediment sites, dredging has resulted in higher concentrations of the constituent of concern in surface sediments after implementation. As a result, the risks are increased as opposed to decreased.

Second, although one of USEPA's goals of Alternative HBHA-4 is to provide an improved benthic habitat in a portion of the pond, dredging, no matter how effective, will never contribute to this end. The HBHA Pond is a man-made structure designed to retain stormwater, and its bottom is prone to anoxic conditions. Even if all the arsenic-containing sediments were removed, anoxia would likely continue, preventing the development of thriving communities.

Third, the primary transport mechanism assumed in the Feasibility Study (FS) is scouring of the arsenic-containing sediment from the bottom of the pond and downstream migration of these sediments. This, however, is not the case. Rather, the sediments in the HBHA Pond sorb arsenic entrained in groundwater as the groundwater discharges to the surface water. Further, hundreds of years of sorptive capacity remain in the sediments. Dredging these sediments would actually destroy an effective, functioning arsenic removal mechanism. In addition, since surface water velocities in the pond are quite low (a result of the pond's design as a retention basin), sediments are not scoured and transported downstream with any regularity.

Finally, USEPA significantly underestimated the volume of sediments that would be dredged from the southern portion of HBHA Pond if its Proposed Plan is implemented. USEPA's 6,700 cubic yard estimate of sediment volume was derived by multiplying the areal extent of the HBHA Pond south of the proposed northern cofferdam (135,000 square feet) by an assumed average sediment thickness of 1.33 feet (roughly equivalent to the 41-centimeter average sediment thickness of the 1991 GSIP Phase 2 Remedial Investigation data set). During implementation of the Final GSIP Scope of Work (SOW) in 2001, sediment thickness was measured at 22 locations throughout the HBHA Pond. Using this sediment thickness data, the portion of HBHA Pond to be dredged under USEPA's Proposed Plan contains approximately 10,000 cubic yards of sediments, almost 50 percent more than the sediment volume (6,700 cubic yards) used in the Proposed Plan to determine the costs for performance of this remedial action. Since sediment removal costs constitute a substantial proportion of the total capital costs for the HBHA Pond remedial action, USEPA significantly underestimated the cost of implementing its Proposed Plan.

For all of these reasons, implementing USEPA's Proposed Plan for dredging arsenic-containing sediments from the HBHA Pond is not likely to be an effective remedial action.

5.2 Wells G&H Wetland and Cranberry Bog Conservation Area Sediments

USEPA's Proposed Plan for excavation and removal of near-shore sediments in the Wells G & H Wetland and the Cranberry Bog Conservation Area should not be implemented for the following reasons:

- **Capping of near-shore sediments with arsenic concentrations greater than Preliminary Remediation Goals (PRGs) will not increase access to impacted sediments in deeper water areas in the Wells G&H Wetland because access to these areas is already restricted by existing physical impediments;**
- **Caps designed to prevent dermal contact can be built so that increases in grade elevation are kept to a minimum; and**
- **Access to capped areas, and/or deeper water sediments, can be controlled using biological barriers to supplement existing dense vegetation.**

In the FS, USEPA eliminated *in situ* capping as a remedial technology because it allegedly would increase access to deeper wetlands in the Wells G & H Wetland. USEPA's preferred alternative relies on institutional controls (Alternative DS-2) to prevent future worker exposure to arsenic-containing sediments in deeper wetland areas within the HBHA Wetland and Wells G & H Wetland. USEPA's concern with *in situ* capping increasing access to deeper sediments would seem to presume a simplistic capping remedy that would essentially create mounds of soil over the proposed remedial areas.

There are several flaws in this reasoning, which led to screening out what should have been retained as an effective remedial technology. First, Wells G & H Wetland near shore sediments targeted for remediation are not easily accessible. The existing dense vegetation and adjoining rifle range make this wetland both difficult and potentially dangerous to access. Existing potential physical hazards pose far greater impediments to accessing deeper areas within the Wells G & H Wetland than potential access facilitated by above-grade *in situ* capping.

Second, caps can be designed to provide dermal barriers to exposure without excessive thickness (e.g., incorporation of geotextiles). Because the proposed remedial areas are relatively confined, caps placed over wetland sediments would likely settle, keeping increases to the existing grade elevation to a minimum.

Third, USEPA's concerns regarding potential access to deeper sediments as a result of capping could be effectively addressed through use of additional biological barriers to supplement the existing dense vegetation (i.e., planting vegetation containing briars/thorns while avoiding those that produce edible fruits [e.g., blackberry]).

For these reasons, USEPA's Proposed Plan for near-shore sediments should not be implemented.

5.3 References

Tetra Tech NUS, Inc., 2005. Draft Final Feasibility Study, Remedial Investigation/Feasibility Study, Industri-Plex Site, Woburn, Massachusetts.

Roux Associates, Inc., Environmental Science and Engineering, Inc., and PTI Environmental Services, 1992. Ground-Water/Surface-Water Investigation Plan, Phase 2 Remedial Investigation Draft Report.

Roux Associates, Inc., 2002. Final GSIP Scope of Work Volume 4, Downgradient Transport Draft Report.

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Education:

M.S. in Environmental Engineering, University of Massachusetts, Lowell, 1994.
B.S. in Civil Engineering, University of Maine, 1985.

Previous Employment:

Haley & Aldrich, 1985 – 1986.
Ebasco/ Enserch Environmental/ Foster Wheeler Environmental, 1986 – 1998.

Professional Experience:

Coosa River, AL. Project manager for the off-site component of a RCRA facility investigation (RFI) evaluating the presence and significance of PCBs in a 15,000-acre reservoir and 40 miles of tributary creeks associated with the Coosa River. The investigation includes a sediment sampling program to characterize the creek system, soil sampling efforts for the adjoining floodplain area, a fish collection program, and surface-water sampling and modeling to assess the PCB fate and transport within the creek/river system.

New Bedford Harbor Superfund Site, New Bedford, MA. Project manager for remediation of approximately 500,000 cy of PCB- and heavy metals-containing sediment. This design-build project included dredging and shoreline containment of sediment in confined disposal facilities (CDFs). Prior to the remedial design phase of this project, served as the project manager responsible for a RI/FS for an 18,000-acre area including sediment, surface water and biota sampling, fate and transport modeling, and human health and ecological risk assessment components. The project also included pilot-scale treatability studies to evaluate treatment options for 15,000 cy of sediment from the hot spot area of the site. These pilot-scale studies included: solvent extraction, vitrification, thermal desorption, solid-phase dechlorination, gas-phase chemical reduction, and solidification/ stabilization. Played an active role in community outreach efforts as the technical spokesperson to the New Bedford Harbor Forum Group and its Treatability Study Subcommittee.

Confidential Waterway in the Northeastern United States. Task leader for the dredging and dredged material transport components for this confidential project. Responsible for designing the removal of 2.65 million cy of PCB-containing sediment while attaining strict performance standards for production, resuspension, and post-dredging residuals.

Former Coal Tar Manufacturing Facility, Everett, Massachusetts. Project manager for a shoreline sediment site located in Boston Harbor that includes a 10-acre upland parcel and approximately 100,000 cy of PAH-containing sediment in a tidal river. Responsible for developing the technical strategy to remove these sediments as part of a Release Abatement Measure (RAM) and the installation of a shoreline wall to sever the link between the uplands portion of the site and the river. As part of designing the RAM, recently led the efforts to complete a large-scale pilot project that tested methods to dredge, process, and transport sediment from the site.

Lake Okeechobee, FL. Feasibility study (FS) lead evaluating a range of remedial alternatives for this 730 square mile lake with approximately 200 million cy of sediment that may require management. The evaluation of remedial alternatives includes consideration of the lake's ecology and critical habitat, archeological/cultural significance, and multiple water-dependent uses including agricultural and public water supply, a waterway between the Gulf of Mexico and the Atlantic Ocean, flood control, and recreation/ tourism.

Convair Lagoon, San Diego, CA. Project engineer for a San Diego shoreline site with PCB-containing sediment. Responsible for conducting FS evaluations, assessing PCB cleanup levels, and directing design activities for the selected cleanup alternative. Design elements included capping, limited removal, water treatment, relocation of area storm drains, and water-quality monitoring to protect environmental resources during construction. Provided expert witness testimony in support of the remedial cleanup plan to the California Regional Water Quality Control Board during the public hearing process. Also supported technical outreach efforts with the local grass-roots community organization, the Environmental Health Coalition.

Passaic River Superfund Site, NJ. Project manager for an FS to assess sediment containing dioxins, furans, and a wide range of organic and inorganic constituents within a six-mile portion of this urban river. Initial FS efforts are focused on evaluating the universe of remedial technologies including an evaluation of sediment treatment technologies and performing a series of site-specific treatability studies.

Howes Sound, Squamish, B.C., Canada. Project manager for a large sediment site adjacent to a former chlor-alkali manufacturing facility. Responsible for evaluating historical sediment, surface water, biota, groundwater, and aerial photographs to assess the potential impact of a former landfill in the area.

Confidential Site, Fraser River, Burnaby, B.C., Canada. Project coordinator for the design and construction activities for this site located on the Fraser River. Responsible for coordinating implementation of the $15 million capping and dredging remedy.

Ashtabula River, Lake Erie, OH. Sediment strategy specialist responsible for developing cleanup approaches for approximately 1 million cy of PCB-containing sediment.

Confidential Site, Lake Champlain, NY. Technical lead for the design and implementation of a monitoring program to assess dredging operations to remove approximately 120,000 cy of PCB-containing sediment from the lake.

Berry's Creek NPL Site, Northern NJ. Technical lead for the engineering aspects of this estuarine mercury discharge NPL site encompassing more than 400 acres of the Hackensack Meadowlands. Responsible for evaluating a range of potential remedial scenarios for both the creek and wetland portions of the site, including developing detailed cost estimates.

Confidential Site in Western U.S. Technical lead evaluating the potential environmental liability associated with a large watershed adjacent to an NPL site that historically supported mining operations. The evaluation included potential remedial response activities and natural resource damage aspects of this 1,500 square mile watershed.
Former Fireworks Manufacturing Site, Southeast MA. Principal-in-charge for studies conducted at this former fireworks manufacturing site to assess the potential presence of mercury. The site includes a large pond and creek system that received mercury through the release of mercury fulmonate used in the manufacturing process. The facility also manufactured munitions during war times and as a result, the investigation activities *included precautions for unexploded ordinances (UXOs) still present in some site areas.*

Major Northeast Waterway. Peer review lead for a former industrial site located on a major waterway in the Northeast. Responsibilities included peer review of an FS prepared by the project's consultant. The review focused on checking the document for the appropriate evaluation of remedial alternatives and recommendations.

Commencement Bay Superfund Site, Middle Waterway, WA. Senior technical consultant to the remedial design team for the Middle Waterway Problem Area of the Commencement Bay Superfund Site. This 24-acre area of the bay has sediments with elevated levels of PAHs and PCBs. As the senior technical consultant, was responsible for reviewing project deliverables and providing technical direction and guidance to the project team for developing the overall design strategy.

Commencement Bay Nearshore/Tideflats Superfund Site, WA. Project engineer providing technical support for the Commencement Bay Nearshore/Tideflats Superfund site. This support included a variety of technical tasks to assist in developing a final remedy for the Hylebos Waterway portion of the site. Responsible for evaluating sediment remediation technologies including capping, dredging, subaqueous and nearshore containment, as well as sediment and water treatment.

Norwood PCB Superfund Site, Norwood, MA. Project manager for treatment operations to remediate 60,000 tons of PCB-containing soil/sediment using an innovative technology, solvent extraction. Project activities included preparing detailed engineering plans and specifications, and conducting contract negotiations with technology vendors.

Massachusetts DEP Priority Disposal Site, Shirley, MA. Project manager for MCP Phase II, III, and IV studies to address this 51-acre former industrial site with petroleum hydrocarbons, heavy metals, SVOCs, and VOCs in both soil and groundwater. Also responsible for developing cost estimates for several remedial alternatives to address an on-site coal ash landfill.

Pinette's Salvage Yard Superfund Site, Washburn, ME. Remedial design project manager for a Superfund site with PCB- and VOC-containing soil and groundwater. Responsible for directing design activities to complete plans and specifications for the excavation and treatment of soil and groundwater. The soil treatment component involved both incineration and solvent extraction, and included participating in a Superfund Innovative Technology Evaluation (SITE) Program Demonstration for a solvent extraction process.

Wells G&H Superfund Site, Woburn, MA. FS lead for the river study component of this project. Responsible for identifying and evaluating remedial technologies to support the development of remedial alternatives for sediment in the Aberjona River.

Nyanza Chemical Superfund Site, Ashland, MA. FS lead for a 35-acre property historically occupied by several dye manufacturing companies. Directed the feasibility study to evaluate the overburden and shallow bedrock aquifers containing a mixture of VOCs, SVOCs, and heavy metals.

Previously was the manager of laboratory testing and services at Haley & Aldrich, Inc. Responsible for overall operation and management of the laboratory providing physical and chemical testing of soils, data analysis and interpretation services, and bench-scale testing for FSs.

Developed and implemented a bench-scale testing program to optimize design parameters for a low-permeability cap, constructed primarily with free-draining soils. The low permeability was achieved by using a proprietary bentonite mixture under optimal conditions. These conditions were determined through a comprehensive bench-scale testing and evaluation program that examined a wide range of mixing ratios for the propriety bentonite, free draining soils, and water content.

Designed and implemented testing programs for clay materials that were to be used to cap and/or line hazardous waste and municipal landfills. The programs also included construction QC testing of the clay materials during and following placement.

Worked for several construction companies in New England including Modern Continental Construction, Slattery Construction, and Morse Diesel Construction.

Publications and Presentations:

C.R. Barnes, C.S. Koll and A.S. Fowler. 2002. Delineation of Volatile Organic Compounds in Stream Bottoms by Passive Vapor-Diffusion Samplers. *Poster Presentation for the Sediment Management Seminar 2002.*

K. Lukasiewicz, A. Fowler, S. Perry, M. Eves, R. Houck and R. Mohan. 2002. Lake Okeechobee Sediment Management Feasibility Study. *Poster Presentation for the Sediment Management Seminar 2002.*

Hattersley, M., M. Shivell, and A.S. Fowler. 2000. GIS – An Effective Tool for Management of Sediment Sites. *Poster Presentation for the Sediment Management Seminar 2000.*

Fowler, A.S. and R.J. Gleason. November 6-7, 1997. Developing Common Sense Remedial Solutions For the New Bedford Harbor Superfund Site. *Strategic Environmental Management Using Risk-Based Approaches Seminar,* Las Vegas, Nevada.

Doward-King, E.J., R.J. Kadeg, A.S. Fowler. and S. Pavlou. 1992. Use of Risk Assessment, Risk Management, and Engineering/Economic Feasibility Analysis in

Remedial Decision Making for Contaminated Soils. *Risk Assessment/Management Issues in the Environmental Planning of Mines*, pp. 63-66.

Fowler, A.S. and M.R. Hanson. June 16-21, 1991. Ambient Air Monitoring of Dredging and Disposal of PCB Contaminated Sediment at a Marine Superfund Site: New Bedford Harbor, Massachusetts. *84th Annual Meeting & Exhibition of the Air and Waste Management Association*, Vancouver.

Phelps, D.K., D.J. Hansen, J.K. Scott, and A.S. Fowler. 1988. Monitoring Program in Support of the Pilot Study of Dredging and Dredged Material Disposal Methods, New Bedford, Massachusetts Superfund Site. *HMCRI's 9th National Conference and Exhibition.*

6.0 Comments on USEPA's Proposed Plan for the West Hide Pile

Based on Roux Associates' review of USEPA's Proposed Plan and the Administrative Record documentation, USEPA's selected groundwater remedy for the West Hide Pile is seriously flawed and should not be implemented because:

- **No remedial action is needed at the West Hide Pile to protect public health because potential future human health risks associated with groundwater impacts at the West Hide Pile can be adequately addressed through implementation of institutional controls—as recognized in the Draft Final Feasibility Study Report and in the Proposed Plan and discussed in Section 1.0 of this document—and because the Custodial Trust owns the land and will not allow groundwater use for industrial or car wash purposes.**
- **No remedial action is needed to protect the environment because there are no documented unacceptable current or potential future ecological risks associated with groundwater impacts at the West Hide Pile (including discharge to surface water). In addition, benzene concentrations in groundwater at the West Hide Pile have decreased considerably since the early 1990s via natural processes, with current levels well below the relevant Massachusetts Contingency Plan (MCP) standard for groundwaters discharging to surface water; and**
- **Enhanced in-situ bioremediation cannot be implemented to treat benzene in groundwater at the West Hide Pile as proposed in USEPA's Proposed Plan because of the very high oxygen demand resulting from the presence of soluble organic carbon from hides in the groundwater beneath the West Hide Pile.**

6.1 Human Health Risk Management with Institutional Controls

As discussed in the Draft Final Feasibility Study Report, groundwater at the West Hide Pile contains benzene at concentrations alleged to exceed human health risk-based threshold concentrations for potential future-use scenarios. Although these future exposure scenarios are unfounded hypotheses, any future human exposures to groundwater at the West Hide Pile can be readily prevented or controlled. As recognized in the Draft Final Feasibility Study Report, this can be readily accomplished through the use of institutional controls, which have already been incorporated into all of the groundwater alternatives evaluated during the Feasibility Study except, of course, for the "no-action" alternative. In fact, groundwater use restrictions are already part of the institutional controls (grants of environmental protection) ready for inauguration at the Industri-plex Site.

The protectiveness of institutional controls from a human-health perspective is indicated in the Draft Final Feasibility Study Report as follows:

> **"Alternative GW-2...would provide protection of human health...through institutional controls...." (Page 4-51)**
>
> **"Alternative GW-3...and Alternative GW-4...would also provide protection of human health...through the use of institutional controls." (Page 4-52)**
>
> **"...the level of human health protection provided by [Alternatives GW-3 and GW-4] would be similar to that provided by Alternative GW-2...." (Page 4-52)**

Moreover, as also recognized in the Draft Final Feasibility Study Report, institutional controls by themselves are adequately protective of human health (i.e., without the need for additional remedial measures). For example, Table 3-2 of the Draft Final Feasibility Study Report indicates that of the four remedial alternatives evaluated for groundwater, only the "no-action" alternative would not protect human health in the long term without other measures.

Institutional controls prohibiting groundwater use can be readily implemented at the West Hide Pile because the Custodial Trust owns this property and can place appropriate restrictions in the deed. Commercial, industrial, residential and agricultural development will not be allowed on this property, facilitating enforcement of institutional controls. Therefore, from a human-health perspective, there was no need for USEPA to include enhanced in-situ bioremediation for the West Hide Pile in its Proposed Plan.

6.2 No Ecological Risk from Groundwater Discharge to Surface Water

There are no unacceptable ecological risks at the Site attributable to benzene in groundwater at the West Hide Pile, as indicated in the Draft Final Feasibility Study Report:

> **"Once discharged to the sediments and surface water [of Lower South Pond], the benzene [in groundwater at the West Hide Pile] is likely being attenuated by biodegradation, chemical degradation, volatilization, and dispersion as seen in the HBHA Pond." (Page 1-23)**
>
> **"...the only area of unacceptable ecological risk is in the HBHA Pond...." (Page 1-30)**

Benzene concentrations in groundwater at the West Hide Pile have decreased significantly from 1991/1992 to 2002 as shown in the tables below:

OW-31 (9-14')		RX-18 (8-13')		RX-18 (15-20')		RX-18 (25-30')	
6/90	48,000 µg/L	12/02	3,900 µg/L	12/02	4,800 µg/L	12/02	170 µg/L
10/90	36,000 µg/L	12/02	4,100 µg/L				
12/91	63,000 µg/L						
Note: GSIP records also indicate that OW-31 may have been screened from 12-14'.							

WP-3 (0.2-10.2')		RX-19 (8-13')		RX-19 (17-22')		RX-19 (25-30')	
12/91	12,000 µg/L	12/02	3.7 µg/L	12/02	940 µg/L	12/02	51 µg/L
Note: Due to shaping and grading of the West Hide Pile during implementation of the Soil Remedy in the mid-1990's, the ground surface at the location of WP-3 was raised several feet.							

As the data show, benzene concentrations detected in the shallow groundwater interval (8 to 13 feet) at Final GSIP Scope of Work (SOW) locations RX-18 and RX-19 are much lower than the benzene concentrations detected respectively at GSIP Phase 1 and 2 monitoring wells OW-31 and WP-3, which were present at roughly the same locations and which were screened over the same general intervals as their Final GSIP SOW analogues. Current benzene concentrations in groundwater at the West Hide Pile are well below the current and proposed future MCP Method 1 GW-3 standards for benzene (7,000 and

10,000 µg/L, respectively), promulgated for the protection of surface waters into which groundwaters discharge.

Given the absence of any chemical-specific ARARs for Site groundwater (as discussed in Section 2.1.1 of the Draft Final Feasibility Study Report) or any other regulatory driver for groundwater cleanup at the West Hide Pile, the absence of unacceptable ecological risks associated with benzene in groundwater at the West Hide Pile demonstrates that there was no need for USEPA to include enhanced in-situ bioremediation for the West Hide Pile in its Proposed Plan.

6.3 Enhance In-Situ Bioremediation is Technically Impracticable

Since enhanced bioremediation was only evaluated at the process level during the Feasibility Study, USEPA was not able to adequately evaluate its difficulty of implementation, degree of remediation feasible, and cost of implementation over the long run at the West Hide Pile. The Feasibility Study recognized that uncertainty exists regarding the effectiveness of *in-situ* technologies that rely on liquid-delivery systems to treat groundwater (Table 4-12D) and that the aquifer's high organic carbon content—attributable to both natural peat deposits and waste animal hides—could impact the logistics of an in-situ bioremediation remedy (page 3-19). However, no detailed discussion was presented regarding this organic matter's potentially limiting effect on the overall success of the proposed remedy for the West Hide Pile, nor in fact was the specific appropriateness and applicability of ORC™ (Regenesis Oxygen Release Compound) at the West Hide Pile ever supported with Site data. Rather, to address the limited uncertainties identified in the Draft Final Feasibility Study Report, treatability testing was included as an element of the West Hide Pile component of the Proposed Plan. However, it was inappropriate for treatability testing of this type to have been included as an element of a remedial alternative being evaluated in a Feasibility Study, based on USEPA's own guidance ("Guidance for Conducting Treatability Studies under CERCLA",; EPA/540/R-92/071a). This guidance specifies two distinct types of treatability studies (pilot testing):

- **Pre-Record of Decision (ROD) Treatability Studies, conducted to determine implementability, effectiveness, etc., in support of the detailed analysis of a Feasibility Study; and**
- **Post-ROD Treatability Studies, conducted to optimize remedial design.**

The treatability study proposed in the Draft Final Feasibility Study Report is clearly of the pre-ROD type, as indicated in Table GW-4-A:

> **"Due to the fact that this alternative utilizes in situ treatment technologies that are less developed...and more sensitive to the site-specific hydrogeology and groundwater geochemistry, pre-design investigations would be performed...to verify its effectiveness."**

This treatability testing should have been performed beforehand to support the Feasibility Study and certainly should be performed before the Record of Decision. Had treatability testing been performed in advance, it would have become evident that the organic matter associated with or derived from the waste animal hides buried within the West Hide Pile are a readily degradable organic material that will consume a majority of any injected oxygen. This large oxygen sink will not only require the injection of oxygen at quantities several orders of magnitude greater than would be required in a normal aquifer, but will also impede the migration of oxygen-enriched groundwater away from the point of oxygen injection by consuming the oxygen rapidly. As a result, further reductions in the concentration of benzene in West Hide Pile groundwater will likely require the injection of oxygen in quantities designed to cause the complete degradation of the soluble organic carbon from the hides. Consequently, enhanced *in-situ* bioremediation cannot feasibly be implemented to treat benzene in groundwater at the West Hide Pile as proposed in USEPA's Proposed Plan is technically infeasible.

6.4 References

Tetra Tech NUS, Inc., 2005. Draft Final Feasibility Study, Remedial Investigation/Feasibility Study, Industri-Plex Site, Woburn, Massachusetts.

Roux Associates, Inc., Environmental Science and Engineering, Inc., and PTI Environmental Services, 1991. Ground-Water/Surface Water Investigation Plan Phase 1 Remedial Investigation Final Report.

Roux Associates, Inc., Environmental Science and Engineering, Inc., and PTI Environmental Services, 1992. Ground-Water/Surface-Water Investigation Plan, Phase 2 Remedial Investigation Draft Report.

Roux Associates, Inc., 2003. Letter Report to Mr. D. Michael Light, Industri-Plex Site Remedial Trust, Re: Final GSIP Scope of Work Source Area Investigation.

7.0 Comments on USEPA's Proposed Plan for Monitoring

Based on Roux Associates' review of the Proposed Plan and the Administrative Record documentation, we have concluded that USEPA's approach for long-term monitoring of the effectiveness and protectiveness of their Proposed Plan is seriously flawed and should not be adopted in its current form. This conclusion is based on the following two considerations:

- **During the feasibility study process, long-term monitoring evolved from a multi-medium approach to a medium-specific approach that is contrary to the USEPA's own Conceptual Site Model approach and framework for monitoring plan development, and is not integrated to the extent warranted by the *interdependent nature of the preferred remedial alternatives*; and**
- **This medium-specific approach results in an inappropriately extensive sampling program.**

7.1 *Long-Term Monitoring Approach*

In Sections 3.2 through 3.5 of the Draft Final Feasibility Study Report (Development of Remedial Alternatives), multi-medium monitoring is initially identified as an element of several of the preferred remedial alternatives. For example, at this stage of the Feasibility Study process, Alternative GW-2 included "long-term monitoring of groundwater, surface water, and sediments" (page 3-14); likewise, Sediment Alternative 5 (later termed Alternative HBHA-4) included "periodic surface water and sediment monitoring...as well as periodic groundwater monitoring" (page 3-33). Inclusion of multi-medium monitoring as an integral part of these remedial alternatives was appropriate, considering both the USEPA's own Conceptual Site Model:

- **Arsenic and benzene plumes in groundwater beneath various portions of the Industri-plex Site;**
- **Plumes migrating to and converging and commingling at the north end of HBHA Pond;**
- **Discharge of the arsenic and bezene plumes into HBHA Pond; and**
- **Arsenic and benzene largely sequestered and attenuated in HBHA Pond.**

Multi-medium monitoring is also appropriate because of the interdependent nature of many of the remedial alternatives being evaluated (e.g., the reliance of Alternative GW-2 on Alternative HBHA-4).

However, contrary to the USEPA's own framework for monitoring plan development, this integrated, multi-medium approach was not carried into the Detailed Analysis portion of the Feasibility Study process, as evidenced by the ultimate specification of medium-specific monitoring plans throughout the tables provided in Appendix B of the Draft Final Feasibility Study Report (i.e., long-term groundwater monitoring was placed in Alternative GW-2, surface water monitoring in the Surface Water Remedy, and sediment monitoring in the Sediment Remedy.) As a result, instead of a long-term monitoring program designed to test and monitor the Conceptual Site Model hypothesis of sequestration and attenuation of Site-related constituents in the HBHA Pond—where, not coincidentally, the bulk of the capital costs of the remedy are proposed to be expended—the Proposed Plan includes non-integrated monitoring of an apparently site-wide network of 15 to 20 monitoring well clusters (45 to 60 wells), another 15 wells in the former Lake Mishawum area, 20 sediment-sampling locations throughout the HBHA Pond, and 10 surface-water sampling locations along the length of the Aberjona River.

7.2 Long-Term Monitoring Objectives

The objective of long-term monitoring for the Site is to monitor the effectiveness and protectiveness of the proposed remedial actions. However, due to the non-integrated nature of the long-term monitoring program proposed by USEPA, most of the data generated can not be used to meet this objective. For example, groundwater and surface water data will be developed for many areas of the Site where changes in contaminant concentrations will have little or no impact on the effectiveness or protectiveness of the proposed remedial actions, since there are no current risks in these areas and potential future risks will be managed by institutional controls. Also, some of the analytical parameters (e.g., semivolatile organic compounds) are proposed for media and locations where they don't exist or where their presence has little or no effect on overall Site risks. Lastly, sampling frequencies proposed in the various medium-specific long-term monitoring plans, which range from quarterly to semi-annually, are also inappropriate. Typically, quarterly or semi-annual sampling is performed to identify seasonal trends, such as fluctuations in contaminant concentrations associated with higher or lower water levels. However, seasonal monitoring is clearly not needed for the duration of long-term monitoring.

7.3 References

Tetra Tech NUS, Inc., 2005. Draft Final Feasibility Study, Remedial Investigation/Feasibility Study, Industri-Plex Site, Woburn, Massachusetts.

U.S. Environmental Protection Agency, 2004. Guidance for Monitoring at Hazardous Waste Sites: Framework for Monitoring Plan Development and Implementation. OSWER Directive No. 9355.4-28.

Lawrence McTiernan, PG, LSP

Principal Hydrogeologist

Technical Specialties:
Management of environmental investigations and remedial actions at hazardous waste sites, including CERCLA, RCRA, and MCP sites; Regulatory negotiations; Litigation Support; ASTM Phase I and II site assessments and EPA All Appropriate Inquiries standard; Support for property acquisitions/divestitures; Sedimentary geology and sediment transport.

Experience Summary:
16 years of experience: Principal, Senior, Project and Staff Hydrogeologist with Roux Associates

Credentials:
B.A. Geology, Lafayette College, 1987
M.S. Marine Environmental Sciences, State University of New York at Stony Brook, 1989
Professional Geologist, Pennsylvania, 1995
Licensed Site Professional, Massachusetts, 2005

Professional Affiliations:
National Ground Water Association
Licensed Site Professional Association

Key Projects:

- Project Manager and then Principal-in-Charge for ongoing Remedial Investigation at the Industri-Plex Superfund Site in Woburn, Massachusetts (No. 5 on the original NPL). Site contains VOCs and metals in soil, groundwater, surface water, and sediment. Major activities have included the following: technical impracticability (TI) demonstration involving evaluation of historical site groundwater data, modeling groundwater and contaminant flow systems and various pump-and-treat scenarios, and demonstrating the TI of achieving ROD IRM cleanup objectives for groundwater via pump and treat; preliminary intrinsic remediation demonstration involving collection of data to demonstrate that benzene, toluene, arsenic, and chromium groundwater plumes are being attenuated through intrinsic processes within the aquifer and within wetland sediments; source-area investigations that included geophysical surveys and Geoprobe sampling of soil gas, soil and groundwater; a pond/wetland sediment transport/remobilization study involving automated sampling of surface-water inflows and discharges during baseflow and storm conditions; vertical profiling of groundwater quality along 16 multi-point sampling transects; Geoprobe sampling of a buried former lakebed; negotiation and preparation of work plans and Project Operations Plans (FSP, QAPP, HASP); and general agency negotiations.

- Principal-in-Charge for 25-site portfolio of retail service station investigation and remediation projects for major New England petroleum distributor/retailer. Projects included assessment and remediation at active and former retail service stations and construction oversight for UST closures and service station renovations.

- Principal-in-Charge for Interim Groundwater Monitoring Program at Stamina Mills Superfund Site in North Smithfield, Rhode Island. Project included low-flow sampling of multi-zonal bedrock wells and sampling of several residential wells, and was being performed in conjunction with dual-phase SVE remediation of source zone and shallow overburden being performed by others.

- Project Manager and then Principal-in-Charge for Groundwater Remedy at the Fulton Terminals Superfund Site in Fulton, New York. Site groundwater was impacted by chlorinated VOCs. Negotiated and implemented an Expedited Pumping Program (EPP) as an alternative to ROD-specified groundwater remedy. EPP involved short-term (12 weeks) pump-and-treat using mobile system and an existing on-site well, periodic sampling of groundwater, and modeling of post-pumping natural attenuation of residual groundwater impacts. Project also included geophysical survey to determine extent and decay rate of freezewall (Soil Remedy) remnants that delayed complete attenuation of groundwater contamination. Successfully argued, based on success of EPP, that additional active remediation of site groundwater was not necessary, and won EPA approval to prepare Construction Completion Report. NYSDEC has downgraded the site from Class 2 to Class 4. Currently performing Long-Term Groundwater Monitoring Program to monitor residual VOC concentrations at two downgradient wells which marginally exceed standards.

- Project Manager for a supplemental remedial investigation at the Pollution Abatement Service (PAS) Superfund Site in Oswego, New York (No. 7 on the original NPL). Site contains VOCs, metals, pesticides, and PCBs in soil, groundwater, surface water, and sediment. Project involved delineating a plume of VOCs in bedrock groundwater, evaluating effectiveness of bedrock pumping to restore bedrock groundwater quality, evaluating potential impacts of bedrock pumping on effectiveness of existing overburden groundwater containment system, delineating the extent of pesticides and PCBs in adjacent creeks and wetlands, identifying potential upstream sources of pesticides and PCBs, and evaluating potential engineering improvements to existing cap/containment system. Successfully demonstrated technical impracticability of bedrock pump-and-treat remedy selected in ROD, resulting in EPA's issuance of an ESD; successfully linked upstream sources to sediment PCB contamination at site; and successfully demonstrated that site is not the source of PCBs in nearby wetland. Latter two demonstrations led to No Further Action ROD for wetland sediments. Also assisted in negotiating of new consent order which relaxed long-term pumping and monitoring requirements.

- Project Manager for RCRA corrective action program at a 100+ year-old former manufacturing site in southeastern Massachusetts. Site contains chlorinated solvents, metals, and cyanide in soil, groundwater, surface water, and/or sediment. To date, project has involved deep bedrock coring (including angled drilling); evaluation for DNAPL; additional well installation; sampling of groundwater, surface water, sewers, soil gas and indoor air; imminent hazard evaluations, and soil-vapor intrusion modeling. Performed limited feasablity study for stabilization measures to address hot-spot soils. Successfully demonstrated additional source for downgradient contamination. Assisting client in marketing and sale of property.

- Project Manager for MCP reponse actions at an active petroleum bulk storage terminal in western Massachusetts. Project has included Phase V operation & maintenance of an air-sparge/SVE system and post-remediation assessment of soil and groundwater quality. Currently evaluating potential for site closure.

Lawrence McTiernan, PG, LSP

Principal Hydrogeologist

- Project Manager for MCP Response Actions at a large active industrial facility in northeastern Massachusetts with multiple releases/RTNs. Site soils and groundwater are impacted mainly by chlorinated VOCs, but also by cyanide, ammonia, and metals. Completed supplemental Phase II Comprehensive Site Assessment activities for a historic Tier IB release including additional contaminant delineation, evaluating potential contributions from an upgradient property, and evaluated the efficiency of existing remediation systems. Performed Phase I Initial Site Investigation activities and prepared Tier Classification Submittal (Tier 1C) for a newer release. Conducted preliminary assessment of third release discovered during due diligence activities, including SRM Evaluation due to proximity of surface water. Also assisted client with property transactional issues, including due diligence, deed restrictions, future liability issues, and access needs.

- Project Manager for supplemental Phase II Comprehensive Site Assessment activities at a retail service station in northeastern Massachusetts. Developed closure strategy to "risk away" exceedences of MCP Method 1 Standards using Method 2 approach. Successfully demonstrated that Method 1 GW-2 and GW-3 Standards for VPH fractions did not apply at site based on evidence for limited vapor-phase migration and absence of VPH at sentinel well combined with declining post-soil remedy source-area concentrations. Prepared Method 2 Risk Characterization and Response Action Outcome.

- Project Manager for MCP response actions required for a release of petroleum hydrocarbons adjacent to a subsurface interstate petroleum transmission pipeline. Project activities have included Phase I Initial Site Investigation activities, Tier Classification (Tier II), and scoping of preliminary Phase II Comprehensive Site Assessment activities designed to delineate the extent of impacts and evaluate potential sources of contamination.

- Project Manager for a litigation support project at a site in New York City with groundwater impacted by PCE. Project involved reviewing and evaluating data developed by opposing side's consultant, performing a limited field investigation, and producing a report demonstrating the likelihood of an off-site source of the PCE in groundwater beneath the site. Entered into "investigation-only" voluntary cleanup program agreement with NYSDEC, through which a No Further Action certification was achieved, resulting in favorable settlement of litigation. NYSDEC later identified and confirmed nearby off-site source of PCE.

- Project Manager for NCP-compliant remedial investigation (RI) at a manufacturing facility in Pennsylvania. Site contained chlorinated solvents in soil and groundwater. RI involved source-area identification; delineation of the extent of impacted media through soil gas, soil, and groundwater sampling; and evaluation of contaminant fate and transport, including slug testing and analysis.

- Project Manager for a pre-design investigation conducted in support of a constructed wetland remedy at a manufacturing plant in tidewater Virginia. Project involved evaluating existing data, scoping and implementing a limited investigation designed to improve the understanding of site hydrogeology, and calculating flux of metals of concern to groundwater discharge areas.

- Project Manager during decommissioning of a manufacturing facility in Rhode Island. Project included due diligence site assessment, UST closure, decontamination of indoor areas containing metals-laden dust, and production-well abandonment.

- Project Manager for development of a remedial investigation work plan at a state Superfund site in a karstified area of Tennessee. Site contained VOCs and SVOCs, metals, and pesticides in soil, groundwater, surface water, and sediment. As part of work plan development, reviewed existing hydrogeologic data and conducted preliminary karst evaluation. Also coordinated implementation of cap-repair IRM.

- Project Manager for NCP-compliant Phase 2 remedial investigations at five manufacturing facilities in Pennsylvania and North Carolina. Sites contained VOCs and PCBs in soil, groundwater, and sediment. Projects involved completing delineation of the extent of impacted media to support an FS and risk assessment at each site.

- Project Manager for Phase II investigations at seven car dealerships on Long Island, New York. Each Phase II involved a review of previous consultants' Phase I reports, Geoprobe soil and groundwater sampling, and review of agency files for several adjoining properties.

- Project Manager for a hydrogeologic investigation at a landfill site in West Virginia, in connection with landfill expansion permitting. Responsibilities also included assistance in preparation of state Part I and Part II permit applications.

- Project Manager for over 25 Phase I property transfer site assessments throughout New York and New England.

Alternative Remedial Action Plan

Multiple Source Groundwater Response Plan Study Area

Woburn, Massachusetts

August 31, 2005

Prepared For:

Pharmacia Corporation (f.k.a. Monsanto Company)
By its Attorney-in-Fact
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1.0 Alternative Remedial Action Summary

Protection of public health and the environment would be achieved in a more protective and effective manner if the following Alternative Remedial Action was to be implemented instead of USEPA's Proposed Plan:

Media	Location	Alternative Remedial Action
Surface and Subsurface Soil	Former Lake Mishawum	Institutional controls to restrict access to surface and subsurface soils
		Long-term groundwater monitoring
Groundwater	Halls Brook Holding Area Pond	Permeable subaqueous reactive cover over existing sediments in the bottom of HBHA Pond to sorb arsenic as groundwater discharges to surface water
		Long-term groundwater monitoring
	West Hide Pile	Institutional controls to restrict groundwater use
Sediments	Halls Brook Holding Area Pond	Flow controls to increase sediment deposition
		Long-term sediment monitoring
	Halls Brook Holding Area Wetland	Flow controls to increase sediment deposition
		Institutional controls to restrict access to sediments
	Wells G&H Wetland and Cranberry Bog Conservation Area	In-situ capping to prevent exposure to near-shore sediments
		Biological barriers (thorn bushes) to limit access to deep water sediments
	Wells G&H Wetland - Deep Areas	Institutional controls to restrict access to deep water sediments
Surface Water	Halls Brook Holding Area	Long-term surface-water monitoring

Institutional controls would be implemented on those properties located within the boundaries of former Mishawum Lake with concentrations above appropriate risk-management levels to restrict access to arsenic-containing soils. Massachusetts Contingency Plan (MCP) Activity and Use Limitations (AULs) would be used to implement these institutional controls.

A permeable, subaqueous reactive cover, consisting of sand, or other granular material, and reactive iron, would be installed in HBHA Pond on top of existing sediments to supplement the arsenic-removal capacity of the these sediments. Arsenic migration control would be achieved by sorption of arsenic on iron-rich sediments beneath the reactive cover and reactive iron in the permeable subaqueous cover as arsenic-containing groundwater discharges to surface water in HBHA Pond. Long-term monitoring of sediments in HBHA Pond would be performed to assess the arsenic sorption capacity of the reactive cover.

Migration of sediments from Halls Brook Holding Area would be controlled by installing flow control structures and devices in HBHA Pond and Wetland to decrease surface water flows and increase sediment deposition, thereby decreasing the Total Suspended Solids (TSS) flux from Halls Brook Holding Area. These actions would remove up to 85 percent of the TSS generated in runoff from a 100 year storm. HBHA Wetland enhancement would create new benthic invertebrate habitats and also result in significant improvements in wetlands species diversity, wildlife habitat and hydrologic function through supplemental planting and hydraulic modifications. Long-term surface water monitoring would be performed at the outlet of HBHA to determine arsenic flux under storm and non-storm conditions.

Capping near-shore sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area would isolate these sediments in place in a manner that would prevent human exposure. Installation of these caps would create upland islands that would increase habitat diversity within the existing wetland systems. Capped areas would be re-vegetated with plants inhospitable to humans to create natural biological barriers to the capped areas and deter access to deep sediments in the interior of the wetland. Capping would add to the mosaic of habitats present in this riparian system, providing new habitat types and increased habitat edges and assure long-term protection of human health and the wetland ecosystem. Institutional controls would be implemented as MCP AULs to restrict access to deep water sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area.

Institutional controls, which are ready to be inaugurated, would be used to restrict groundwater use at the West Hide Pile. MCP AULs would be used to restrict groundwater use on those other portions of the Study Area where arsenic and benzene are migrating in groundwater toward and discharging to HBHA Pond.

2.0 Development of Alternative Remedial Action

Soil - This component of the Alternative Remedial Action does not involve treatment or removal, it does provide protection of public health and the environment by controlling potential exposures to soils with concentrations greater than appropriate risk-management levels through implementation of institutional controls. Institutional controls that would be implemented include prohibitions on the use of impacted properties for a day care facility, and prohibitions on excavation without regulatory oversight and adequate health and safety precautions (engineering controls, personal protective equipment, etc.) to minimize or prevent direct contact with impacted soil during removal activities and control potential on-site and off-site spread of impacted soil.

Institutional controls would be implemented to prevent future exposures to soils in the former Mishawum Lake bed area with arsenic concentrations greater than appropriate risk-management levels. The primary components of this portion of the Alternative Remedial Action would include:

- Conducting a pre-design investigation to delineate the limits of soil above appropriate risk-management levels so that properties requiring institutional controls may be identified;
- Mobilization and demobilization of required personnel and equipment to conduct property surveys;
- Coordination with local, state and federal agencies and property owners to develop property-specific deed restriction documents;
- Filing of deed restrictions and/or other appropriate institutional controls and providing a long-term maintenance program;
- Long-term inspections to ensure that the deed restrictions are being enforced;
- Long-term monitoring of groundwater to evaluate constituent of concern status and migration; and
- Performance of 5-year reviews to monitor the effectiveness of the remedy.

Institutional controls, implemented as MCP AULs would take the form of land-use restrictions, specifically the prohibition of use by a day care facility, and prohibitions on excavation in this area, including paved areas and below building foundations, unless adequate precautions (engineering controls, personal protective equipment, etc.) were taken to minimize or prevent direct contact with impacted soil during removal activities. These types of controls would be designed to address potential human health risks from exposure to surface and subsurface soils in the former Mishawum Lake bed area with concentrations above appropriate risk-management levels. This remedial action does not involve any actions that will reduce the toxicity, mobility or volume of impacted soil. The only on-site activities that would be conducted under this remedial action are long-term groundwater monitoring and periodic reviews of site conditions and risks. A review of site conditions and risks would be conducted every five years since impacted soils would remain on site above levels that allow for unlimited use and unrestricted exposure.

Groundwater - This component of the Alternative Remedial Action involves reduction in mobility and toxicity through treatment, provides protection of public health by preventing or controlling potential exposures to groundwater through institutional controls and protects the environment by preventing benthic invertebrates from contacting impacted sediments and surface water. Migration of impacted groundwater to HBHA Pond, and Wetland and then downstream as surface water to the Aberjona River, would be controlled by intercepting it in HBHA Pond where natural processes, which would be enhanced with iron-containing minerals or media, are currently degrading or sequestering the constituents of concern such that no unacceptable human health or ecological risks are present downstream of the Pond. The primary components of this portion of the Alternative Remedial Action would include:

- Coordination with local, state and federal agencies and property owners to design and construct a permeable subaqueous reactive cap;
- Mobilization and demobilization of required personnel and equipment to the site for construction of the permeable subaqueous reactive cap;
  - Limited clearing and grubbing for equipment and materials laydown areas;
  - Installation of silt curtains, sedimentation booms and other equipment; and
  - Placement of cap materials through the water column
- Long-term inspections and maintenance of the cap to ensure erosional forces have not deteriorated the cap's thickness thus reducing its effectiveness;
- Coordination with local, state and federal agencies and property owners to develop property-specific deed restriction documents;
- Mobilization and demobilization of required personnel and equipment to conduct property surveys and conduct periodic sampling;
- Filing of deed restrictions and/or other appropriate institutional controls and providing a long-term maintenance program;
- Long-term inspections to ensure that the deed restrictions are being enforced;
- Long-term monitoring of groundwater and sediment to evaluate constituent of concern status and migration; and
- Performance of 5-year reviews to monitor the effectiveness of the remedy.

Installing a permeable subaqueous cover over the entire bottom of HBHA Pond would contain the existing sediments in place and preserve the sorptive capacity of the existing sediments, which are effectively removing arsenic from groundwater as it discharges to the Pond. Addition of reactive material to the cover will provide additional control of the discharge of arsenic to surface water via the groundwater pathway by sorbing arsenic to the reactive material. Natural iron-containing minerals (magnetite, taconite, etc.) or designed media (Zero Valence Iron (ZVI), Granular Ferric Oxides, etc.) are effective sorptive material to include in the sand cover. A sand or other granular material/reactive iron cover would be placed through the water column on top of a geogrid installed on the surface of existing sediments. Arsenic would be sorbed to the reactive iron as groundwater migrates through the permeable reactive cover and discharges to surface water. This permeable reactive cover would keep arsenic out of the iron hydroxide floc that forms at the oxic/anoxic boundary in HBHA Pond.

Human health risks and hazards above risk management criteria from direct contract with impacted groundwater could result from future use of site groundwater as industrial process water or as wash water in a car wash. Institutional controls, implemented as MCP AULs or grants of environmental restriction for those portions of the MSGRP Study Area outside of the Industri-Plex Superfund Site where arsenic and benzene are migrating in groundwater toward HBHA Pond, could limit human exposure to impacted groundwater through restrictions that would prohibit the use of site groundwater for activities that would pose a future human health risk. Since the Custodial Trust owns the property on which the West Hide Pile is located, implementation of restrictions on groundwater use could be readily accomplished through institutional controls that are ready to be inaugurated.

This remedial action at the West Hide Pille does not involve any actions that will reduce the toxicity, mobility or volume of impacted groundwater although it is important to note that benzene concentrations in groundwater, the risk driver at the West Hide Pile, decreased from 63,000 ug/l in 1991 to 4,800 ug/l in 2002. Long-term monitoring is not appropriate because groundwater concentrations of benzene are less than the 7,000 ug/l MCP GW-3 standard for groundwaters discharging to surface water. The only on-site activities that would be conducted under this remedial action are periodic reviews of site conditions and risks. A review of site conditions and risks would be conducted every five years since impacted groundwater would remain on site above levels that allow for unlimited use and unrestricted exposure.

Sediments - This component of the Alternative Remedial Action provides reduction of mobility through treatment, provides protection of the environment by preventing migration of impacted sediments to downstream areas and creates new benthic habitat and higher value wetlands. The primary components of this portion of the Alternative Remedial Action would include:

- **Coordination with local, state and federal agencies and property owners to design and construct flow control structures and devices;**
- **Mobilization and demobilization of required personnel and equipment to HBHA for construction of the flow control structures and devices;**
    - **Limited clearing and grubbing for equipment and materials laydown areas;**

- Installation of silt curtains, sedimentation booms and other equipment to prevent downstream migration of sediments during construction and placement of flow control structures and devices;
- Construction of four low-head dikes, one at the outlet of HBHA Pond and three in HBHA Wetland;
- Construction of storm-water flow deflector at Halls Brook;
- Construction of a low-head dike with spillway, plunge pool and apron at Atlantic Avenue Drainway;
- Construction of a headwall at the ephemeral tributary draining ROW No. 9;
- Installation of silt curtains in HBHA Pond;
- Construction of natural flow deflectors in HBHA Wetland;
- Creation of approximately 1 acre of new benthic habitat;
- Enhancement of approximately 2 acres of existing HBHA wetlands into higher value wetlands through increased vegetation diversity, new mircopool habitat areas and improved hydrologic function; and
- Construction of a micropool at the downstream end of HBHA Wetland.

- Long-term inspections and maintenance of the low-head dikes, flow deflectors, headwall, plunge pools, aprons and silt curtains to ensure hydraulic forces have not impacted performance and reduced effectiveness of the enhanced HBHA;
- Coordination with local, state and federal agencies and property owners to design and construct near-shore sediment caps in the Wells G&H Wetland and Cranberry Bog Conservation Area;
- Mobilization and demobilization of required personnel and equipment to the Wells G&H Wetland and Cranberry Bog Conservation Area for construction of the near-shore sediment caps;
  - Limited clearing and grubbing for equipment and materials laydown areas;
  - Installation of silt curtains, sedimentation booms and other equipment to prevent downstream migration of sediments during cap placement; and
  - Construction and vegetation of in-situ caps.
- Long-term inspection and maintenance at the Wells G&H Wetland and Cranberry Bog Conservation Area to ensure that erosional forces have not deteriorated the cap's thickness thus reducing its effectiveness;
- Coordination with local, state and federal agencies and property owners to develop property-specific deed restriction documents;
- Mobilization and demobilization of required personnel and equipment to conduct property surveys in each wetland;
- Filing of deed restrictions and/or other appropriate institutional controls and providing a long-term maintenance program for each impacted wetand;
- Long-term inspections to ensure that the deed restrictions are being enforced;
- Long-term monitoring of surface water to evaluate constituent of concern status and migration; and

- **Performance of 5-year reviews to monitor the effectiveness of the remedy.**

Installing flow control structures and devices in HBHA Pond and Wetland would decrease surface water flows and increase sediment deposition, thereby decreasing Total Suspended Solids (TSS) flux from Halls Brook Holding Area (Figure 1). In HBHA Pond, a low-head dike with spillway, plunge pool and riprap apron would be constructed at the Atlantic Avenue Drainway confluence, a flow deflector would be constructed at the Halls Brook confluence and a headwall would be constructed at the confluence of the ephemeral stream that enters the Pond just south of NStar Right of Way (ROW) No. 9. In addition, flow deflectors and floating silt curtains would be installed in the Pond and a low head dike, plunge pool and riprap apron would be installed at the Pond outlet. Three low head dikes would be installed in HBHA Wetland to create, from upstream to downstream, a low marsh cell, a high marsh cell, a low marsh cell, all with isolated micropools, and a large terminal micropool downstream of the last cell to reduce flow velocities and increase sediment deposition. Natural earthen flow deflectors would be installed in each of the cells and in the micro pool to enhance sediment deposition. These actions would remove up to 85 percent of the TSS generated in runoff from a 100 year storm. The proposed modifications to the wetlands would create new benthic invertebrate habitat in the micropools. The wetlands enhancements would also result in significant improvements in wetlands species diversity, wildlife habitat and hydrologic function through supplemental planting and hydraulic modifications.

Capping near-shore sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area would isolate these sediments in-place in a manner that would prevent human exposure and erosion and downstream transport of these sediments. Placement of clean fill, compatible with native wetland soil, over the existing sediments would both isolate the sediments and provide a substrate for restoration of the wetland. An effective cap could be designed that would serve as a dermal barrier to recreational receptors and also satisfy the preferred restoration goals for the near-shore wetland areas. Installation of caps would create upland islands that would increase habitat diversity within the existing wetland systems. Re-vegetation of capped areas can also be used to create natural "biological barriers" to prevent, or discourage, access to deep sediment areas in the Wells G&H Wetland. Many plant species present are inhospitable for humans, and re-vegetation of capped areas would incorporate such plants to provide biological barriers to deter access to deep sediments in the interior of the wetland. Indigenous (i.e., native) species from various vegetative strata (e.g. trees, shrubs and vines) are recognized as inhospitable or nuisance species by most recreational users, such as hawthorn, a tree with large thorns on branches and twigs, and cat briar, a dense-growth vine with briars along its stem. Capping would add to the mosaic of habitats present in this riparian system, providing new habitat types and increased ecotones (i.e., habitat edges) and assure long-term protection of human health and the wetland ecosystem. Although the proposed capping and re-vegetation would enhance the habitat value and overall wetland function, any potential loss of wetlands in the Wells G&H and Cranberry Bog Conservation Area as a result of grade elevation (approximately 1 acre total to be capped) would be mitigated by proposed actions in the HBHA Wetland:

- **Creation of approximately 1 acre of new benthic habitat; and**
- **Enhancement of approximately 2 acres of existing HBHA wetlands into higher value wetlands through increased vegetation diversity, new micropool habitat areas and improved hydrologic function.**

Institutional controls, implemented as MCP AULs, would only apply to the deeper sediment sample locations (sediment core sample areas) in the interior portions of the HBHA Wetland and the Wells G&H Wetland. Under this remedial action, institutional controls would be implemented to prevent future exposures to impacted sediment in the vicinity of the sediment core sample areas where potential human health risks and hazards above risk management criteria were identified. Institutional controls would take the form of prohibitions on dredging or excavation in the interior wetland areas unless adequate precautions (e.g. engineering controls, personal protective equipment, etc.) were taken to minimize or prevent direct contact with impacted sediment removed as part of maintenance dredging. These controls would be designed to address the potential human health risks and hazards that were identified under the future dredger scenarios for the HBHA and Wells G&H wetlands. Institutional controls do not involve any actions that will reduce the toxicity, mobility or volume of impacted sediments. The only on-site activities that would be conducted are periodically reviewing site conditions and risks. A review of site conditions and risks would be conducted every five years.

Monitoring - By adapting an integrated approach to site monitoring, monitoring efforts could be focused on arsenic-containing and benzene-containing groundwater discharging from the Industri-plex Superfund Site to surface water in Halls Brook Holding Area Pond, arsenic accumulation in HBHA Pond sediments, the potential for arsenic-containing groundwater from Former Lake Mishawum to discharge into HBHA Wetland and arsenic flux from Hall Brook Holding area wetland via the surface water pathway (Figure 2). Groundwater discharge from the site would be monitored by installing three well clusters at the north end of HBHA Pond to determine whether or not arsenic concentrations were increasing, decreasing or steady state. Sampling would be conducted quarterly for two years, semiannually for three years and annually thereafter. Sediment sampling would be performed annually at three locations in HBHA Pond (upstream end, center and downstream end) to determine the amount of arsenic sorbed to the sediments and the amount of sorption capacity remaining. Three monitoring well clusters would be installed on the eastern edge of HBHA Wetland to determine if arsenic was mobilized from buried lake bottom sediment and migrating to the wetland. One well cluster would be located at the north end of HBHA Wetland, one well cluster would be located in the center of the wetland and the other well cluster would be located at the south end of the wetland. Sampling would be conducted semiannually for five years, annually for five years and discontinued if arsenic is not discharging to surface water at concentrations that would cause an adverse impact on public health or the environment. To determine arsenic flux from HBHA Wetland, a surface water sampling station would be maintained at the outlet of the wetland to sample monthly baseflow and storms with greater than 0.5 inches of precipitation. Samples would be analyzed for TSS and Total and Dissolved Arsenic.

3.0 Detailed Analysis of Alternative Remedial Action

The Alternative Remedial Action that was developed in Section 2.0 is analyzed in detail in this section. The detailed analysis of the alternative provides information to facilitate selection of a specific remedy or combination of remedies. The detailed analysis of this alternative was developed in accordance with the NCP (40 CFR 300.430(e)) and the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, Oct 1988).

3.1 Evaluation Criteria

In conformance with the NCP, seven of the following nine criteria were used to evaluate each of the Alternative Remedial Action during the detailed analysis. The last two criteria, state and community acceptance, were not addressed because they require state and public comments on the RI/FS.

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume Through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

Under the NCP, the selection of the remedy is based on the nine evaluation criteria, which are categorized into three groups:

- Threshold Criteria - The overall protection of human health and the environment, and compliance with ARARs are threshold criteria that each alternative must meet in order to be eligible for selection.

- Primary Balancing Criteria - The five primary balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

- Modifying Criteria - The state and community acceptance are modifying criteria that will be considered in remedy selection.

Brief, general discussions of these evaluation criteria are presented in the following text. Detailed analyses of the Alternative Remedial Action using these evaluation criteria are presented in Section 3.2. The comparative analysis of the remedial alternatives is presented in Section 4.0.

3.1.1 Overall Protection of Human Health and the Environment

This evaluation criterion provides a final check to assess whether or not each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria including: long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The evaluation focuses on whether or not a specific alternative achieves adequate protection and how risks are eliminated, reduced, or controlled, and whether Remedial Action Objectives (RAOs) would be achieved.

3.1.2 Compliance with ARARs

ARARs are considered during the detailed evaluation of alternatives. Alternatives are assessed on whether or not they attain ARARs. When an ARAR cannot be met, the basis for justification of a waiver under CERCLA, or within the specific requirement, is presented. The actual determination of which ARARs are requirements is made by USEPA in consultation with the MDEP.

31.3 Long-Term Effectiveness and Permanence

Under this criterion, the alternatives are evaluated for long-term effectiveness, permanence, and the degree of risk remaining after the RAOs have been met. The following components are evaluated:

- Magnitude of residual risks - Assesses the residual risk remaining from untreated wastes or treatment residuals at the conclusion of remedial actions, the remaining sources of risk, and the need for 5-year reviews.

- Adequacy and reliability of controls - assesses controls that are used to manage treatment residuals or remaining untreated wastes. This assessment includes addressing: the likelihood of technologies to meet required efficiencies or specifications, type and degree of long-term management, long-term monitoring requirements, operation and maintenance (O&M) functions to be performed, uncertainties associated with long-term O&M, potential need for replacement of technical components and associated magnitude of risks or threats, degree of confidence in controls to handle potential problems, and uncertainties associated with land disposal of untreated wastes and residuals.

3.1.4 Reduction of Toxicity, Mobility or Volume through Treatment

This criterion addresses the statutory preference for remedies that employ treatment as a principal element by assessing the relative performance of different treatment technologies for reducing the toxicity, mobility, or volume of the contaminated media. Specifically, the analysis should examine the magnitude, significance, and irreversibility of the estimated reductions.

The degree to which remedial alternatives employ treatment that reduces toxicity, mobility, or volume is assessed by considering the following factors:

- The treatment processes that the remedies employ, the media they would treat, and threats addressed;
- The approximate amount of hazardous materials that would be destroyed or treated;
- The degree of expected reduction in toxicity, mobility, or volume as a result of treatment;
- The degree to which the treatment is irreversible;
- The type and quantity of residuals that would remain following treatment, considering the persistence, toxicity,

mobility, and bioaccumulation capacity of the contaminants of concern and impacted media, and
- The ability of alternatives to satisfy the statutory preference for treatment as a principal element.

3.1.5 Short-Term Effectiveness

The assessment of short-term effectiveness during construction or implementation until the RAOs are met includes consideration of the following factors:

- Potential short-term impacts to the community during remedial actions and whether risks may be addressed or mitigated;
- Potential impacts to, and protection of, the workers during remedial actions;
- Potential adverse environmental impacts that result from construction and implementation of the alternative, and the reliability of mitigation measures, and
- Time until RAOs are achieved.

3.1.6 Implementability

The ease or difficulty of implementing a remedial alternative is assessed by considering the following factors during the detailed analysis:

- Technical Feasibility:
  - Degree of difficulty or uncertainties associated with constructing and operating the alternative;
  - Technical difficulties associated with the technologies' reliability that could result in schedule delays;
  - Likelihood of additional remedial actions and anticipated ease or difficulty in implementation, and
  - Ability to monitor the effectiveness of the remedy and risks of exposure if monitoring is insufficient to detect remedy failure.
- Administrative Feasibility:
  - The need to coordinate with other offices and agencies, and obtain necessary approvals and permits.
- Availability of Services and Materials:
  - Availability of adequate capacity and location of treatment, storage, and disposal services, if required;
  - Availability of necessary equipment and specialists;
  - Availability of treatment technologies comprising the alternative, sufficient demonstration of the technologies, and availability of vendors, and
  - Availability of services and materials, and the potential for obtaining competitive bids.

3.1.7 Cost

A detailed cost analysis is performed for each alternative to assess the net present worth cost to implement the remedial actions. The cost analysis consists of the following:

- Estimation of capital (direct and indirect) and annual O&M costs;
- Development of costs with an accuracy in the range of plus 50 percent to minus 30 percent, and
- Calculation of the present worth (capital and O&M costs) of the alternative by discounting to a base year or

current year using a discount rate of seven percent.

3.2 Detailed Analysis of Alternative

The following sections provide a detailed analysis of the proposed Alternative Remedial Action. The analysis evaluates the different components (soil, groundwater, sediments and surface water) of the proposed Alternative Remedial Action against each criterion.

3.2.1 Overall Protection of Human Health and the Environment

Implementation of the Alternative Remedial Action will results in achievement of all applicable RAOs.

Soil – This component of the Alternative Remedial Action is consistent with the USEPA's Proposed Plan. While this component of the Alternative Remedial Action does not involve treatment or removal, it protects public health and the environment by controlling potential exposures to soils with concentrations greater than appropriate risk-management criteria through implementation of institutional controls. Prohibitions on the use of impacted properties for a day care facility would be implemented to prevent future exposures to soils with arsenic concentrations greater than appropriate risk-management criteria. Prohibitions on excavation without regulatory oversight and adequate health and safety precautions (i.e., engineering controls, personal protective equipment, etc.) would be implemented to minimize or prevent construction worker contact with soils in the former Mishawum Lake bed area containing arsenic concentrations greater than appropriate risk management criteria. Groundwater will be monitored to verify soil to groundwater migration has been adequately controlled.

Groundwater – Without remedial action, human health risks and hazards above risk management criteria from direct contact with impacted groundwater could result from future use of site groundwater at the West Hide Pile as industrial process water, or as wash water in a car wash. Addressing groundwater as proposed in the Alternative Remedial Action provides protection of public health through institutional controls, specifically deed restrictions that would implement the existing Grant of Environmental Restriction (GER) to prohibit the use of site groundwater from the West Hide Pile area for industrial process water or car wash use.

Migration of impacted groundwater to HBHA Pond, where it discharges to surface water and creates the potential for benthic invertebrates to come into direct contact with impacted groundwater, would be controlled by intercepting it in HBHA Pond through the placement of a permeable subaqueous reactive cap. The reactive cap would use iron-containing minerals or media to enhance the ongoing natural processes of degradation and sequestration of the constituents of concern. Implementation of this groundwater Alternative Remedial Action would effectively treat groundwater discharging to surface water in the HBHA Pond through the sediments.

USEPA's preferred groundwater alternative does not consider nor take advantage of the beneficial natural sorptive capacity of the existing sediments to naturally treat groundwater discharging to HBHA Pond surface water. The enhanced groundwater treatment that would be provided by a reactive cap placed on existing sediments makes this Alternative Remedial Action for groundwater more protective of public health and the environment than USEPA's preferred alternative. In addition, USEPA's Proposed Plan, which bypasses Halls Brook during storm events, removes a source of natural iron-rich minerals and oxygenated surface water.

Sediments – This Alternative Remedial Action provides protection of human health and the environment by sequestering contaminated sediments within the HBHA Pond beneath a subaqueous permeable reactive cap, which would effectively treat dissolved-phase arsenic in groundwater (as discussed above) and in the sediments. The greatest concern associated with downstream migration of arsenic from the HBHA Pond should be resuspension and transport of iron hydroxide floc with adsorbed arsenic formed at the oxic/anoxic boundary rather than resuspension and transport of the very stable arsenic-containing sediments at the bottom of the pond. Under existing conditions surface water velocities within the Pond are too low to scour the pond-bottom sediments, even during storm flow. The low density iron hydroxide particles are more easily suspended than natural sediments, and their movement constitutes the primary downstream migration mechanism for arsenic. USEPA's preferred alternative for HBHA Pond sediments does not take into account that iron hydroxide floc and sorbed arsenic will not have enough time to settle in the proposed Sediment Retention Cell before water overflows to the Surface Water Polishing Cell and flows downstream. In addition, stormwater inflows from the Atlantic Avenue Drainway and the ephemeral stream from ROW No. 9 will re-suspend any settled floc and sweep it downstream during storm conditions. This Alternative Remedial Action addresses this important transport mechanism through inclusion of engineered flow controls to enhance sedimentation within the pond and the HBHA Wetland. The proposed construction of four low-head dikes would greatly reduce downstream migration of suspended particles, including arsenic-containing iron hydroxide floc, and, thereby, reduce risks.

Although USEPA has not demonstrated that, using reasonable exposure criteria, there is an actual human health impact due to the sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area, this proposed Alternative Remedial Action considers that capping will be used to control exposure to sediments in these areas. *In situ* caps would be placed over existing sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area to prevent recreational exposures to near-shore sediments with concentrations greater than appropriate risk management critieria. In addition to the dermal barrier protection provided by the caps, recreational exposures would be further prevented through re-vegetation of capped areas to create natural "biological barriers" to prevent, or discourage, walking on or through capped areas. In the Wells G&H Wetland, the re-vegetation would supplement the existing vegetation and conditions that currently limit recreational access to even near shore sediments.

Sediments in the deep areas of the HBHA and Wells G&H wetlands are not accessible to recreational visitors. Although construction of caps might elevate the grade in some remediated near shore areas, access would continue to be restricted through the re-vegetation of capped areas to create biological barriers to humans, while enhancing the riparian habitat diversity. Because arsenic concentrations above risk management criteria in deep sediments could pose a risk to future construction workers performing maintenance dredging within the HBHA and Wells G&H wetlands, the same institutional controls proposed by the USEPA for deep wetlands sediments are proposed in this Alternative Remedial Action.

Surface Water - The only unacceptable risk identified by USEPA for surface water was to benthic communities in the HBHA Pond due to exposure to arsenic and benzene in deep surface water. Monitoring will enable detection of any changes in surface water quality at HBHA Wetland outlet that could cause potential risks to the public or the environment.

3.2.2 Compliance with ARARs

Soil – The compliance with Applicable or Relevant and Appropriate (ARARs) for this Alternative Remedial Action for soils is consistent with USEPA's proposed plan, which also recommends institutional controls for surface and subsurface soils in the former Mishawum Lake bed.

Chemical-specific ARARs – There were no chemical-specific ARARs identified for surface or subsurface soils.

Location-specific ARARs – This alternative would comply with all applicable location-specific ARARs in Feasibility Study Tables 4-2B and 4-7B.

Action-specific ARARs – This alternative would comply with all applicable action-specific ARARs in Feasibility Study Tables 4-2A and 4-7A.

Other Criteria, Advisories, and Guidance – This alternative would comply with appropriate risk-management criteria for protection of human health from exposure to surface or subsurface soils in the former Mishawum Lake bed.

Groundwater – Because this Alternative Remedial Action employs institutional controls and a subaqueous permeable reactive cap in the HBHA Pond to effectively treat groundwater *in situ*, the evaluation of the groundwater remedy for compliance with ARARs is generally consistent with USEPA's Alternative GW-4, Plume Intercept By *In-Situ* Groundwater Treatment And Monitoring With Institutional Controls.

Chemical-specific ARARs – This alternative would comply with the chemical-specific ARARs in Feasibility Study Table 4-12C.

Location-specific ARARs – This alternative would comply with all applicable location-specific ARARs in Feasibility Study Table 4-12B.

Action-specific ARARs – This alternative would comply with all applicable action-specific ARARs in Feasibility Study Table 4-12A.

Other Criteria, Advisories, and Guidance – This alternative would comply with appropriate risk-management criteria for protection of human health from exposure to groundwater in the West Hide Pile area, and significantly reduce potential migration of arsenic downstream of the HBHA Pond originating from groundwater discharge into the pond through the sediments.

Sediment – This Alternative Remedial Action treats sediments in the HBHA Pond through placement of the subaqueous cap designed to treat groundwater *in situ*, addresses migration of sediments in the HBHA Pond and Wetland through construction of surface water flow controls (low-head dikes), addresses near shore sediments in the Wells G&H and Cranberry Bog Conservation Area wetlands through capping and re-vegetation to create biological barriers, and prevents exposure to deep wetland sediments through institutional controls. Thus, evaluation of this multi-component alternative for compliance with ARARs is generally consistent with USEPA's evaluations for Alternatives HBHA-3 Subaqueous Cap – Halls Brook Holding Area Pond Sediment and DS-2 Institutional Controls – Deep Sediment. A supplemental evaluation of compliance with ARARs for the proposed capping and re-vegetation to create biological barriers is included below, based on the ARARs compiled in the Feasibility Study for USEPA's preferred Alternative NS-4 Removal and Off-Site Disposal – Near-Shore Sediments.

Chemical-Specific ARARs – Placement of a subaqueous cap in the HBHA Pond would comply with relevant chemical-specific ARARs in Feasibility Study Table 4-15C. *In situ* capping and re-vegetation in Wells G&H and Cranberry Bog Conservation Area wetlands would comply with the pertinent chemical-specific ARARs listed in Feasibility Study Table 4-21C, in a manner similar to USEPA's preferred alternative, NS-4. In Feasibility Study Table 4-23D (Detailed Analysis of Alternative DS-2 Institutional Controls), USEPA determined that institutional controls for deep wetland sediments would not comply with the chemical-specific ARARs in Feasibility Study Table 4-23C. However, Feasibility Study Table 4-23C states that the ARARs will be attained, and that surface water monitoring would be conducted to confirm that sediment contamination that is left in place does not impact surface water, which would also be the case for the Alternative Remedial Action.

Location-Specific ARARs - A subaqueous cap in the HBHA Pond would comply with the location-specific ARARs in Feasibility Study Table 4-15B. *In situ* capping and re-vegetation in Wells G&H and Cranberry Bog Conservation Area wetlands would comply with the pertinent location-specific ARARs listed in Feasibility Study Table 4-21B. The proposed capping and re-vegetation would result in less adverse impacts to the wetland (Federal and State regulatory requirements) caused by the intrusive nature of the excavation activities included as part of the USEPA's preferred alternative, NS-4. Because there are no actions associated with institutional controls for deep wetland sediments, there are no location-specific ARARs identified in the Feasibility Study (Table 4-23B).

Action-Specific ARARs – A subaqueous cap in the HBHA Pond would comply with the action-specific ARARs in Feasibility Study Table 4-15A. *In situ* capping and re-vegetation in Wells G&H and Cranberry Bog Conservation Area wetlands would comply with the pertinent action-specific ARARs listed in Feasibility Study Table 4-21A, in a manner similar to USEPA's preferred alternative, NS-4. Although the Alternative Remedial Action could result in a change in the type of wetland vegetation present (a positive change in terms of habitat diversity), the Alternative Remedial Action is not expected to result in a measurable impact to the flood storage capacity of the wetland. This alternative is expected to comply with action-specific ARARs. In Feasibility Study Table 4-23D (Detailed Analysis of Alternative DS-2 Institutional Controls), USEPA determined that institutional controls for deep wetland sediments would not comply with the action-specific ARARs in Feasibility Study Table 4-23A. This statement contradicts Feasibility Study Table 4-23A that indicates action-specific ARARs will be attained, and that surface water monitoring would be conducted to confirm that sediment contamination that is left in place does not impact surface water, which would also be the case for the Alternative Remedial Action.

Other Criteria, Advisories, and Guidance – A subaqueous cap in the HBHA Pond would comply with appropriate ecological risk-management criteria for HBHA Pond sediment and control migration of arsenic to surface water in the pond. *In situ* capping and re-vegetation in Wells G&H and Cranberry Bog Conservation Area wetlands would comply with appropriate human health risk-management criteria for these wetland sediments as effectively as the USEPA's preferred alternative, NS-4. Institutional controls for deep wetlands sediments would comply with appropriate risk-management criteria.

Surface Water – Monitoring is the preferred alternative for surface water in this Alternative Remedial Action as well as in USEPA's proposed plan. Accordingly, this evaluation of surface water monitoring for compliance with ARARs is consistent with USEPA's Alternative SW-2, Monitoring – Surface Water.

Chemical-specific ARARs – In Feasibility Study Table 4-26D (Detailed Analysis of Alternative SW-2 Monitoring – Surface Water), USEPA determined that surface water monitoring would not comply with the chemical-specific ARARs in Feasibility Study Table 4-26C unless other media-specific alternatives were selected in conjunction with monitoring to address groundwater and sediment contaminant sources. The treatment of groundwater and sediment through the placement of a subaqueous permeable reactive cap in the HBHA Pond will make the chemical-specific ARARs attainable for this alternative.

Location-specific ARARs – Because there are no actions associated with this alternative, no location-specific ARARs were identified in the Feasibility Study (Table 4-26B).

Action-specific ARARs – In Feasibility Study Table 4-26D (Detailed Analysis of Alternative SW-2 Monitoring – Surface Water), USEPA determined that surface water monitoring would not comply with action-specific ARARs in Feasibility Study Table 4-26A unless other media-specific alternatives were selected in conjunction with monitoring to address groundwater and sediment contaminant sources. The treatment of groundwater and sediment through the placement of a subaqueous permeable reactive cap in the HBHA Pond will make the action-specific ARARs attainable for this alternative.

Other Criteria, Advisories, and Guidance – In Feasibility Study Table 4-26D (Detailed Analysis of Alternative SW-2 Monitoring – Surface Water), USEPA determined that surface water monitoring would not comply with appropriate risk-management criteria for protection of benthic communities in the HBHA Pond. As above, monitoring in conjunction with capping will improve deep surface water quality within the HBHA Pond with respect to arsenic, even if baseline conditions causing anoxia continue to constrain the overall benthic habitat quality.

3.2.3 Long-Term Effectiveness and Permanence

Soil – This component of the Alternative Remedial Action is consistent with the USEPA's Proposed Plan. Prohibitions on the use of impacted properties for a day care facility through institutional controls would be maintained in perpetuity. Similarly, prohibitions on excavation without regulatory oversight and adequate health and safety precautions would remain in place to assure long-term effectiveness of institutional controls.

Groundwater – Deed restrictions that would prohibit the use of site groundwater at the West Hide Pile for industrial process water or car wash use would assure long-term effectiveness and permanence.

Sediments in the bottom of the HBHA Pond are effectively removing arsenic from groundwater and there are hundreds of years of remaining sorptive capacity in these sediments. The placement of a reactive cap over the entire sediment bed of the HBHA Pond will increase sorptive capacity because existing sediments and the permeable, subaqueous, reactive cap, would be working in concert to treat arsenic in groundwater, achieving long-term effectiveness. Under current and predictable geochemical conditions, the sorption of arsenic by iron-containing minerals or media in the native sediments and reactive cap are stable and essential not reversible, assuring greater permanence than USEPA's Proposed Plan. Placement of the subaqueous cap would include installation of silt curtains, sedimentation booms, and other equipment to prevent downstream migration of resuspended sediments. A geogrid would be used to minimize sediment resuspension during placement. Residual risks are expected to be less than under USEPA's preferred alternative since the most contaminated materials will remain sequestered at the bottom of the pond.

Sediments – This Alternative Remedial Action, which includes sequestering contaminated sediments within the HBHA Pond beneath a subaqueous permeable reactive cover would be constructed using appropriate engineering controls and would result in less residual risk to benthic invertebrates than USEPA's preferred alternative by virtue of sorbing arsenic within the reactive cap layer. As previously noted, the HBHA Pond was intended and designed as a stormwater detention basin and not as aquatic habitat and would remain limited in habitat quality due to anoxia in the bottom waters resulting from its design; this is also true for USEPA's Proposed Plan. Through the construction of flow control structures and devices in the HBHA Pond and HBHA Wetland, natural deposition would be enhanced, promoting the long-term effectiveness and permanence of arsenic sequestration within the highly stable sediments of the HBHA Pond and Wetland. The design of the flow control structures within the pond and wetland would reduce surface water flows and increase sediment/floc deposition passively, a fail-proof design which adds to the long-term effectiveness and permanence of the remedial action. Construction in the HBHA Pond and Wetland would include appropriate and reliable engineering controls to prevent disturbance of the subaqueous cap (described above). Because the proposed flow controls will promote settling of iron hydroxide floc and any sorbed arsenic that might migrate through the existing sediments and permeable, subaqueous reactive cover, this alternative should result in less residual risk than USEPA's preferred alternative.

The long-term effectiveness and permanence of capping in the Wells G&H Wetland and Cranberry Bog Conservation Area Wetland would be enhanced through the re-vegetation. To verify re-vegetation successfully creates biological barriers, an adaptive management plan would be implemented. The adaptive management plan would provide for planting over three to five years, rather than a single event. This strategy would allow for adjusting the volume and mix of vegetation used to achieve the desired habitat edges, as well as biological barriers.

The proposed alternative would include adequate and reliable controls during construction. Based on comparison of *in situ* capping and dredging/excavation effectiveness at other aquatic sites, capping is expected to pose less risk of re-contamination than dredging/excavation, and the creation of natural biological barriers in capping areas would result in less residual direct contact exposure risk to recreational visitors than USEPA's excavation alternative.

Inaccessibility to sediments in the deep areas of the HBHA and Wells G&H wetlands will be provided through maintaining institutional controls. The residual risk of direct contact exposure resulting from someone wading into deep areas of the wetlands, or future dredgers ignoring the institutional controls guiding construction are remote. In the event of such remote exceptions, direct contact exposure would be expected to be less than the conservative exposure assumptions used in determining the need to avoid exposure to those sediments.

Surface Water – Because of the anticipated effectiveness of groundwater treatment through placement of a subaqueous permeable reactive cap, the residual risk resulting from monitoring without performing any other remedial actions for surface water is expected to be small. Low oxygen concentrations still occur in deep surface water despite effective arsenic removal from groundwater discharging to surface water; this condition may pose the greatest residual risk to benthic invertebrates and fish. No engineering controls are associated with this alternative.

3.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Soil – Consistent with the USEPA's Proposed Plan, institutional controls do not provide any reduction of toxicity, mobility, or volume through treatment.

Groundwater – Institutional controls that would prohibit the use of site groundwater at the West Hide Pile do not provide reduction of toxicity, mobility, or volume through treatment. However, concentrations of benzene are attenuating naturally in the West Hide Pile area, having decreased from 63,000 µg/L in 1991 to 4,800 µg/L in 2002, which is less than the applicable 7,000 µg/L MCP GW-3 surface water protection standard.

The reactive cap will supplement the natural effectiveness of existing sediments in treating groundwater to remove arsenic as it discharges to surface water in the HBHA Pond. Although bench-scale testing would be conducted to determine the most effective iron minerals/materials or combination of amendments to achieve arsenic removal from groundwater, it is expected that nearly all arsenic can be removed from groundwater discharging to surface water in the northern portion of the HBHA Pond. Although the arsenic is not destroyed in this treatment, it is stable, not leachable, and essentially irreversibly bound within the sediments and reactive cap layer under current and reasonably anticipated geochemical conditions. This binding of arsenic within the sediments and reactive cap layer will considerably reduce the toxicity and mobility of arsenic in surface water downstream of the northern portion of the HBHA Pond. This Alternative Remedial Action is consistent with the statutory preference for treatment as a principal remedy element.

Sediments – Although groundwater discharge to surface water is limited to the northern portion of the HBHA Pond, sediments throughout the pond contain arsenic. The placement of the permeable reactive cap over the entire sediment bed will provide treatment for arsenic in sediments equivalent to *in situ* stabilization. However, treatment will only occur for the very limited concentration of arsenic in sediment porewater that, without the cap, would be available for interaction with surface water and subsequent potential release from the existing sediment bed. The reactive cap will irreversibly capture/treat most of that small concentration of dissolved arsenic. Therefore, this alternative is consistent with the statutory preference for treatment.

Capping in the Wells G&H Wetland and the Cranberry Bog Conservation Area, and integrated wetland restoration, would not include treatment of contaminated wetland sediment or dewatering effluent. As such, this Alternative Remedial Action would not reduce toxicity, mobility, and volume of contaminants in the wetlands through treatment. Although the Feasibility Study cites the reduction of toxicity, mobility, and volume through the treatment of 3,000,000 gallons of dewatering effluent, it should be noted that this treatment is necessitated because of the proposed excavation of wetland sediments containing approximately 50% water. *In situ* groundwater within the wetland does not require remediation. Because solids remaining from dewatering operations would likely be disposed of at a landfill, the USEPA's preferred alternative offers no advantage over *in situ* capping under this evaluation criterion.

Consistent with the USEPA's Proposed Plan, institutional controls proposed for preventing direct contact exposure to deep sediments do not provide any reduction of toxicity, mobility or volume through treatment.

Surface Water – Monitoring would not reduce the toxicity, mobility, or volume of contaminants through treatment.

3.2.5 Short-Term Effectiveness

Soil – Institutional controls prohibiting use of the Former Lake Mishawum should not present any short-term impacts or inconvenience to the community or site workers, and there are no impacts associated with construction or implementation. Requirements for adequate precautions (engineering controls, personal protective equipment, etc.) for any excavation in this area should also not present any remedy-related short-term impacts.

Groundwater – Deed restrictions that would prohibit the use of site groundwater at the West Hide Pile for industrial process water or car wash use should not present any short-term impacts or inconvenience to the community or site workers, and there are no impacts associated with construction or implementation.

The placement of a reactive cap over the entire sediment bed of the HBHA Pond will require mobilization and demobilization of required personnel and equipment to the site. However, this Alternative Remedial Action for groundwater should not pose any greater short-term impacts to the community or workers during the construction than the USEPA's preferred alternative involving interception and treatment in the northern portion of the HBHA Pond. Proven reliable measures would be implemented to control sediment resuspension during placement (geogrids or other suitable geosynthetics, silt curtains, sedimentation booms, etc.). Because of the current degraded condition of any potential benthic habitat within the pond, associated with anoxic conditions in the sediments, cover placement would not cause adverse short-term environmental impacts. The remedial action would address groundwater RAOs for the HBHA Pond upon completion of the construction; implementation is expected to take approximately four months.

Sediments – The potential short-term impacts to the community and construction workers, potential short-term environmental impacts, and time until RAOs are achieved for capping in the HBHA Pond are discussed above. The construction of flow control structures and devices in the HBHA Pond and HBHA Wetland would pose considerably fewer short-term impacts to the community than the hydraulic dredging of HBHA Pond sediments proposed in USEPA's Proposed Plan, which involves hazardous material processing on land, then offsite transport for disposal. Similarly, the construction of flow control structures would pose less risk of worker exposure to hazardous materials. Increased sedimentation from the flow control structures should not cause any adverse environmental impacts. The combination of capping and construction of flow control structures will immediately present an improved benthic habitat upon construction completion. However, anoxic conditions will to continue for HBHA Pond sediments under this or USEPA's Proposed Plan, since the pond was designed as a stormwater detention basin rather than aquatic habitat, and its very design is what creates the anoxic conditions.

In situ capping and integrated wetland restoration in the Wells G&H and Cranberry Bog Conservation Area wetlands would pose minimal impacts during construction. The only anticipated impact would be traffic associated with construction vehicle and equipment transportation, transportation of clean capping materials, and workers traveling to and from the site. As with USEPA's preferred alternative, these impacts would be mitigated through traffic control planning. However, because of the need to transport hazardous materials for offsite disposal and to treat dewatering effluent onsite, USEPA's preferred alternative will generate considerably more traffic than the Alternative Remedial Action, and has a greater potential for community impacts should there be any accidental releases of untreated water or solid hazardous wastes during transportation. Under either alternative, construction would be conducted in accordance with all required health and safety regulations and procedures, and appropriate engineering controls. However, removal of contaminated sediment, dewatering and treatment of effluent, and transportation of arsenic-containing sediments to an offsite facility for disposal under USEPA's proposed plan would pose a far greater risk of worker exposure to chemical contamination, and is a more labor intensive project.

Capping and re-vegetation pose some unavoidable impacts to the environment resulting from construction within a wetland. Similar degrees of short-term impact are expected under this Alternative

Remedial Action and USEPA's Proposed Plan. However, because dredging/excavation under USEPA's Proposed Plan, resuspension and downstream transport of arsenic-containing sediments during dredging could expand the spatial area and volume of wetland sediment to be excavated could be expanded, which would increase the potential for short-term impacts resulting from USEPA's Proposed Plan. The Alternative Remedial Action of capping and restoration is expected to require less than four months to implement. However, the adaptive management plan would involve planting vegetation over three to five years, which would be the expected timeframe for the wetlands portion of the remedy to become fully effective.

The institutional controls proposed for the deep wetlands sediments would not pose any potential short-term impacts to the community, construction workers, or the environment.

Surface Water – Monitoring would not cause any short-term impacts to the community or the environment. Because the surface water does not pose a human health risk, there would not be any expected adverse impacts to workers implementing this alternative even though sampling would be done by trained environmental samplers supplied with personal protective equipment.

3.2.6 Implementability

Soil – The proposed institutional controls for the Former Lake Mishawum area could easily be implemented, although would require coordination with local, state, and federal agencies and property owners to develop property-specific deed restriction documents.

Groundwater – Deed restrictions that would prohibit the use of site groundwater at the West Hide Pile for industrial process water or car wash use could easily be implemented. The Custodial Trust owns the property on which the West Hide Pile is located, reducing the need for coordination of deed restrictions.

Sediment capping is an established technology that would be very implementable within the HBHA Pond. The geometry of the pond would facilitate the implementation of engineering controls to minimize sediment resuspension and downstream transport.

Sediments – Implementability of capping within the HBHA Pond was discussed above. The additional construction of a low-head dike at the pond outlet, installation of three more dikes within the HBHA Wetland, and the proposed capping and re-vegetation within the Wells G&H and Cranberry Bog Conservation Area wetlands are also technically implementable. The required construction services and materials for capping and flow controls are available within the site region. The administrative feasibility of the Alternative Remedial Action for sediments will hinge upon the permitting required to perform construction within delineated wetlands, and mitigation of lost wetlands. The Alternative Remedial Action will involve more construction within wetlands, specifically the HBHA Wetland, than USEPA's Proposed Plan, and thus face greater administrative implementability impediments. Institutional controls for deep wetland sediments are readily implementable.

Surface Water – The proposed monitoring would be technically and administratively implementable.

3.2.7 Cost

The estimated costs for this Alternative Remedial Action are summarized below.

Media	Location	Alternative Remedial Action	Cost
Surface and Subsurface Soil	Former Lake Mishawum	Institutional controls to restrict access to surface and subsurface soils and periodic inspections	$1.4MM
		Long-term groundwater monitoring	$0.1MM
Groundwater	Halls Brook Holding Area Pond	Permeable subaqueous reactive cover over existing sediments in the bottom of HBHA Pond to sorb arsenic as groundwater discharges to surface water	$3.0MM
		Long-term groundwater monitoring	$0.9MM
	West Hide Pile	Site-wide institutional controls to restrict groundwater use	$0.2MM
Sediments	Halls Brook Holding Area Pond	Flow controls to increase sediment deposition	$0.5MM
		Long-term sediment monitoring	$0.3MM
	Halls Brook Holding Area Wetland	Flow controls to increase sediment deposition	$4.3MM
		Institutional controls to restrict access to sediments and periodic inspections	$0.4MM
	Wells G&H Wetland and Cranberry Bog Conservation Area	In-situ capping to prevent exposure to near-shore	$0.6MM
		Biological barriers (thorn bushes) to limit access to deep water sediments	$0.3MM
	Wells G&H Wetland - Deep Areas	Institutional controls to restrict access to deep water sediments and periodic inspections	$0.4MM
Surface Water	Halls Brook Holding Area	Long-term surface-water monitoring	$1.5MM
		TOTAL ESTIMATED 30-YEAR NPV COST (7% DISCOUNT)	$13.9MM

4.0 Comparative Analysis of Alternative Remedial Action and USEPA's Proposed Plan

In this section, the Alternative Remedial Action and USEPA's Proposed Plan are compared to one another to identify the relative advantages and disadvantages of each potential remedial action. A forced ranking system was used to identify the alternative that best achieves the requirements of the seven NCP evaluation criteria used to evaluate remedial alternatives. In this forced ranking system, the alternative that best meets the requirements of a criterion was awarded a score of 1 and the second best alternative was awarded a score of 2. Using this ranking method, the alternative with the lowest score is the one that best meets the requirements of the seven criteria. This comparative analysis is summarized below:

Forced-Ranking Comparison of Alternative Remedial Action and USEPA's Proposed Plan

Evaluation Criterion	Alternative Remedial Action	USEPA's Proposed Plan
Overall Protection of Human Health and the Environment	1	2
Compliance with ARARs	1	2
Long-Term Effectiveness and Permanence	1	2
Reduction of Toxicity, Mobility or Volume through Treatment	1	2
Short-Term Effectiveness	1	2
Implementability	1	2
Cost	1	2
TOTAL SCORE	7	14

The following sections compare this Alternative Remedial Action with USEPA's Proposed Plan according to each evaluation criterion. The alternatives corresponding to each medium (soil, groundwater, sediments, surface water) are compared and scored using the forced ranking system described above. Identical alternatives, such as surface water monitoring, and institutional controls for surface and subsurface soils in the former Mishawum Lake bed and deep wetland sediments, are scored as 1. The combination of alternatives with the lowest total score is ranked best (1) in the above summary.

4.1 Overall Protection of Human Health and the Environment

While not necessary to achieve the RAOs, USEPA's Proposed Pplan includes *in situ* bioremediation of groundwater at the West Hide Pile. Although bioremediation would generally be considered to provide greater overall protection of human health and the environment than institutional controls, the *in situ* bioremediation as described in USEPA's Proposed Plan will not achieve greater reduction of benzene concentrations than ongoing natural attenuation. Therefore, the institutional controls proposed as part of the Alternative Remedial Action are considered to provide comparable overall protection of human health and the environment. The Alternative Remedial Action proposed for groundwater in the HBHA Pond would more effectively treat groundwater entering the HBHA Pond and discharging to surface water than USEPA's Proposed Plan. Capping sediments in the HBHA Pond and the Wells G&H and Cranberry Bog Conservation Area wetlands would provide greater overall protection of human health and the environment than hydraulic dredging of HBHA Pond sediments and excavation and offsite disposal of near-shore wetland sediments. In total, the Alternative Remedial Action provides greater overall protection of human health and the environment, as summarized below.

Forced-Ranking – Overall Protection of Human Health and the Environment

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	1
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments - Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	12

4.2 Compliance with ARARs

The *in situ* bioremediation as described in USEPA's Proposed Plan will not achieve greater reduction of benzene concentrations than ongoing natural attenuation. Therefore, the institutional controls proposed as part of the Alternative Remedial Action are considered to provide comparable compliance with ARARs. The Alternative Remedial Action proposed for groundwater in the HBHA Pond would more effectively treat groundwater entering the HBHA Pond and discharging to surface water than USEPA's Proposed Plan, thereby providing greater assurance of compliance with appropriate risk-management criteria for arsenic in deep surface water than USEPA's Proposed Plan. While the Alternative Remedial Action would include filling a one-acre area to construct the caps at the Wells G&H Wetland and the Cranberry Bog Conservation Area, this would be more than offset by wetland areas constructed on the surface of the caps. These caps would be vegetated to create a scrub-scrub wetland that would increase the functions and values of wetlands in the Wells G&H and Cranberry Bog Conservation Area through increased diversity. As a result, mitigation for constructing the caps is not be required as the functions and values of the wetland area are being increased and the wetland areas are not being lost. The function and values of the wetlands areas are further increased under the Alternative Remedial Action by constructing a new acre of benthic habitat and enhancing an additional 2.15 acres in the HBHA Wetland. Thus, the Alternative Remedial Action ranks better than the USEPA's Proposed Plan for compliance with location-specific and action-specific ARARs. In total, the Alternative Remedial Action would provide greater compliance with ARARs than USEPA's Proposed Plan, as summarized below.

Forced-Ranking – Compliance with ARARs

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1

Groundwater – West Hide Pile	1	1
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	12

4.3 Long-Term Effectiveness

The *in situ* bioremediation as described in USEPA's Proposed Plan will not achieve greater reduction of benzene concentrations than ongoing natural attenuation. Therefore, the institutional controls proposed as part of the Alternative Remedial Action are considered to provide comparable long-term effectiveness. The Alternative Remedial Action proposed for groundwater in the HBHA Pond would more effectively and irreversibly treat groundwater entering the HBHA Pond and discharging to surface water than USEPA's Proposed Plan. Enhancing sedimentation in the HBHA Wetland through construction of low-head dikes would provide greater long-term effectiveness and less residual risk than the institutional controls proposed by USEPA. Capping sediments in the HBHA Pond and the Wells G&H and Cranberry Bog Conservation Area wetlands would provide greater long-term effectiveness with reliable controls and less residual risk than USEPA's Proposed Plan. In total, the Alternative Remedial Action provides greater long-term effectiveness, as summarized below.

Forced-Ranking – Long-Term Effectiveness

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	1
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	12

4.4 Reduction of Toxicity, Mobility or Volume Through Treatment

USEPA's Proposed Plan for *in situ* bioremediation of groundwater at the West Hide Pile will not provide any greater reduction of benzene toxicity, mobility or volume through treatment than ongoing natural attenuation processes. As a result, the institutional controls proposed as part of the Alternative Remedial Action, which do not include "treatment" per se, are considered comparable to USEPA's preferred alternative under this evaluation criterion. The subaqueous permeable reactive cap proposed for treating groundwater in the HBHA Pond would more effectively reduce the toxicity, mobility and volume of arsenic in groundwater entering the HBHA Pond and discharging to surface water than USEPA's Proposed Plan. The capping of HBHA Pond sediments would also more effectively reduce the mobility of arsenic in sediments through treatment than USEPA's proposed hydraulic dredging. Enhancing sedimentation in the HBHA Wetland through construction of low-head dikes would reduce the mobility of arsenic in sediments through burial of existing sediments by increasingly cleaner suspended particles. Specifically, the reactive cap would reduce release of arsenic into HBHA Pond surface water, where it can co-precipitate on iron hydroxide floc and suspended sediments entering and flowing through the HBHA Pond. Capping sediments in the HBHA Pond and the Wells G&H and Cranberry Bog Conservation Area wetlands would not constitute treatment. Conversely, potential stabilization of dewatered sediments hydraulically dredged from the HBHA Pond and excavated from near-shore wetlands areas would provide some reduction of mobility through treatment. In total, the Alternative Remedial Action would provide greater reduction of toxicity, mobility or volume through treatment, as summarized below.

Forced-Ranking – Reduction of Toxicity, Mobility or Volume Through Treatment

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	1
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	2	1
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	9	11

4.5 Short-Term Effectiveness

This Alternative Remedial Action provides better short-term effectiveness, with fewer impacts to the community and construction workers, than USEPA's Proposed Plan. With the exception of the three- to five-year adaptive management plan for creating natural biological barriers over near-shore wetlands capping areas, the Alternative Remedial Action would achieve RAOs in less time than USEPA's Proposed Plan. In total, the Alternative Remedial Action would provide greater short-term effectiveness, as summarized below.

Forced-Ranking – Short-Term Effectiveness

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	2
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	13

4.6 Implementability

USEPA's Proposed Plan for HBHA Wetland sediments, institutional controls, would be more implementable than the Alternative Remedial Action, construction of flow control structures to enhance sedimentation. Because of the permitting necessary for any construction in wetlands that might impair wetlands habitat or create net loss of wetlands, despite an overall enhancement of riparian wetland habitat diversity, the administrative feasibility of the Alternative Remedial Action for near-shore sediments within the Wells G&H and Cranberry Bog Conservation Area wetlands and USEPA's preferred alternative are considered comparable. In total, the Alternative Remedial Action would be more implementable, as summarized below.

Forced-Ranking – Implementability

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	2
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	2	1
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	1
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	11

4.7 Cost

USEPA's proposed institutional controls for the HBHA Wetland sediments would cost less to implement than the construction of flow controls described in the Alternative Remedial Action. In total, the Alternative Remedial Action would achieve greater protection of human health and the environment at less cost than USEPA's Proposed Plan.

Forced-Ranking – Cost

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	2
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	2	1
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	2
TOTAL SCORE	9	13


OPEN WATER
LOW MARSH
HIGH MARSH
RIPRAP
FLOW DEFLECTOR
SILT FENCE
FLOW DIRECTION
N
150'
0
150'
ENHANCED SEDIMENT RETENTION
AND WETLAND ENHANCEMENT
CONCEPTUAL PLAN
1

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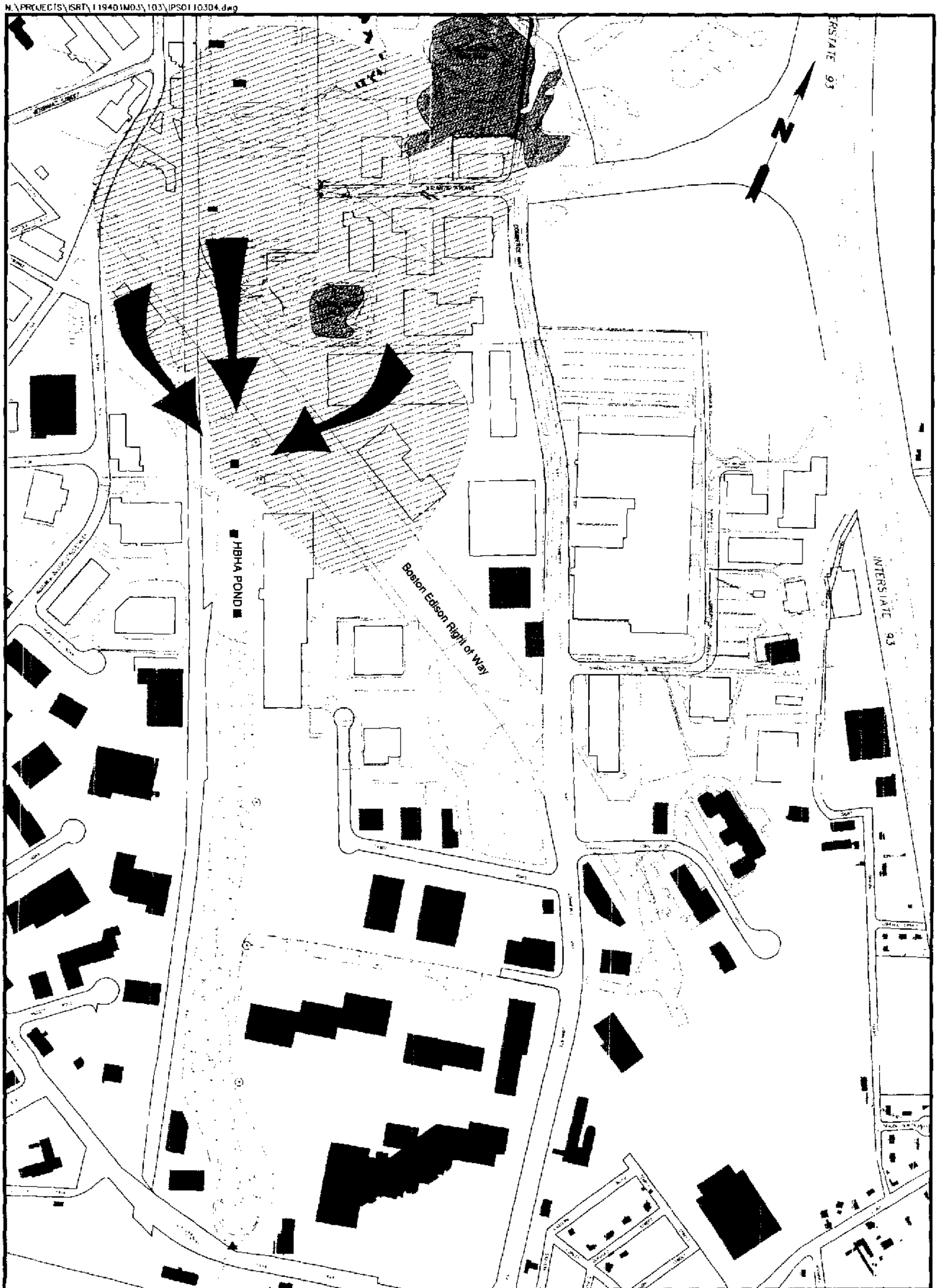

LEGEND

- POTENTIAL LOCATIONS OF MONITORING WELL CLUSTERS
- POTENTIAL LOCATIONS OF HBHA SURFACE WATER/SEDIMENT MONITORING POINTS
- POTENTIAL LOCATION OF HBHA WETLAND OUTLET SURFACE WATER MONITORING STATION
- GENERALIZED DIRECTION OF GROUNDWATER FLOW (PER TTNUS)
- APPROXIMATE AREA OF GROUNDWATER IMPACTS EXCEEDING PRGs (PER TTNUS)

450' 0 450'

Title:

CONCEPTUAL PROPOSED LONG-TERM MONITORING NETWORK

INDUSTRI-PLEX SUPERFUND SITE
WOBURN, MASSACHUSETTS

Prepared For

INDUSTRI-PLEX SITE REMEDIAL TRUST

ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: LM	Date: 8/22/05	FIGURE
	Prepared by: CRS	Scale: AS SHOWN	1
	Project Mgr: LM	Office: MA	
	File No: IPSD110304	Project: 119401M03	

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August 31, 2005

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BY HAND DELIVERY

Joseph F. LeMay
Remedial Project Manager
US EPA—New England
One Congress Street, Suite 1100 (HBO)
Boston, MA 02114-2023

Re: Comments from Stauffer Management Company, LLC to EPA's MSGRP RI, FS, and Proposed Plan for Industri-plex Site

Dear Mr. LeMay:

I am writing on behalf of my client, Stauffer Management Company LLC to submit the following written comments to EPA's MSGRP Remedial Investigation Report, Feasibility Study, and Proposed Plan for the Industri-Plex Site:

1. The "Comments Submitted by Stauffer Management Company, LLC in response to the Multiple Source Groundwater Response Plan Remedial Investigation Report, Feasibility Study, and Proposed Plan for the Industri-Plex Superfund Site in Woburn, Massachusetts";

2. Letter from Gradient Corporation to Joseph F. LeMay re: EPA's FS and RI, dated August 29, 2005, including Gradient's "Comments on Baseline Human Health Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA, USEPA Region 1, March, 2003," dated October 13, 2003, and the curriculum vitae of Barbara Beck, Ph.D., of Gradient;

3. The Combined "Comments on USEPA's June 2005 Proposed Plan," including the curriculum vitae of individuals contributing to the Combined Comments; and

4. An "Alternative Remedial Action Plan."

Please do not hesitate to contact me if you have questions regarding these materials.

Sincerely yours,

Timothy J. Casey

Enclosures

cc: John D. Beling, Esq.
Luke W. Mette, Esq.
Paul B. Galvani, Esq.

Comments Submitted by Stauffer Management Company, LLC in response to the Multiple Source Groundwater Response Plan Remedial Investigation Report, Feasibility Study, and Proposed Plan for the Industri-Plex Superfund Site in Woburn, Massachusetts

STAUFFER MANAGEMENT COMPANY, LLC

By: ROPES & GRAY LLP

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Dated: August 31, 2005

TABLE OF CONTENTS

INTRODUCTION

Stauffer Management Company LLC ("SMC"), on behalf of the entity formerly known as Stauffer Chemical Company ("Stauffer"), hereby submits the following comments in response to the "Draft Final Multiple Source Groundwater Response Plan ("MSGRP") Remedial Investigation ("RI") Report," the "Draft Final Feasibility Study ("FS")," and the "Proposed Plan—Industri-Plex Superfund Site Operable Unit 2 (including Wells G&H Operable Unit 3)" in Woburn, Massachusetts, all promulgated by the United States Environmental Protection Agency ("EPA"). The MSGRP RI, FS, and Proposed Plan encompass an area that includes the Industri-Plex Site (the "Site")—which is the subject of a previously-entered Consent Decree in litigation between EPA and, among other Potentially Responsible Parties ("PRPs"), Stauffer[1]—as well as the surrounding area, including but not limited to the Wells G&H Superfund Site and the surface water and sediment along the Aberjona River, all of which is referred to collectively herein as the "MSGRP Study Area."[2]

In addition to the comments below, SMC submits herewith the following technical reports:

- Letter from Gradient Corporation to Joseph F. LeMay re: EPA's FS and RI, dated August 29, 2005, including Gradient's "Comments on Baseline Human Health Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA, USEPA Region 1, March, 2003," dated October 13, 2003, and the curriculum vitae of Barbara Beck, Ph.D., of Gradient;

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[1] *See United States v. Stauffer Chemical Company et al.*, Civil Action Nos. 89-0195-MC, 89-0196-MC.

[2] In submitting comments to EPA's RI, FS, and Proposed Plan for the MSGRP Study Area, SMC and Stauffer do not concede that EPA's jurisdiction extends beyond the Site boundaries, or that Stauffer has liability for any contamination, wherever located along the Aberjona River. The Consent Decree applied to the Site only.

- "Combined Comments on USEPA's Proposed Plan," including the curriculum vitae of individuals contributing to the Combined Comments; and

- "Alternative Remedial Action Plan."

The following comments incorporate by reference, rely upon, and are in addition to the attached technical reports.

DISCUSSION

I. EPA'S PLAN IS ARBITRARY, CAPRICIOUS, AND OTHERWISE NOT IN ACCORDANCE WITH LAW

EPA's RI, FS, and Proposed Plan are arbitrary and capricious, and otherwise not in accordance with law in numerous respects, and therefore violate various provisions of the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA") and regulations promulgated thereunder. *See, e.g.*, 42 U.S.C. §§ 9613(h)(1), (j)(2); 40 C.F.R. § 300.430. EPA should review thoroughly the comments and the Alternative Remedial Action Plan submitted by SMC and other interested parties, and should cooperate with SMC and other interested parties, before issuing a Record of Decision ("ROD"), to develop a collaborative approach to remediating the MSGRP Study Area. The result would be a remedy that targets the risks, if any, that actually exist within the MSGRP Study Area in a more effective and cost-efficient manner than the remedy currently proposed by EPA.

A. EPA's Refusal to Accept and Evaluate Meaningful Comment Upon the RI, FS, and Proposed Plan Is Arbitrary, Capricious, and Otherwise Not In Accordance With Law

After having studied the MSGRP Study Area for at least sixteen years after EPA entered into a Consent Decree with PRPs for the Site and agreed to conduct the MSGRP in 1989, EPA has given interested members of the community a scant sixty days to comment publicly on the RI, FS, and Proposed Plan, even though it claims to have evaluated over seventy different possible alternatives before issuing the FS. Such a brief period effectively forecloses any meaningful public comment. Interested parties, including the City of Woburn, require more time to review carefully EPA's proposal, and to participate meaningfully in analyzing proposed remedial alternatives. While interested parties have requested such additional time, EPA has rejected the requests out of hand and without reason.

Even more disturbing, EPA has announced publicly that it intends to issue a ROD by September 30, 2005, the end of its fiscal year. The ineluctable conclusion is that any review by EPA of the comments that are actually submitted on behalf of interested parties will be perfunctory at best, because the Agency will not have adequate time to analyze the comments seriously, and to obtain review within the Agency hierarchy, before preparing its ROD. EPA's current fast-track process, especially in light of the glacial pace at which it has proceeded in studying the MSGRP Study Area, violates CERCLA. The obvious conclusion is that EPA has predetermined the outcome and is going through the motions in a transparent attempt to make it appear that it is complying with regulatory requirements. In fact, EPA will have to give short shrift to any comments, because it has so constrained the process that it cannot do otherwise.

Relatedly, the pace at which EPA has moved from FS to the close of the public comment period reflects an unwillingness on the part of EPA to consult with members of the community who are interested in, and knowledgeable about, the MSGRP Study Area. As an example, in devising its preferred remedial approach, EPA failed to notify, let alone consult with, the United States Army Corps of Engineers. This is despite the fact that the Corps designed the Halls Brook Holding Area Pond (the "HBHA Pond" or the "Pond") as a flood control mechanism, which EPA now proposes to alter significantly without regard for flood control in the area, including downstream in Winchester. Flooding presents a far greater risk than any arsenic sequestered in the sediments buried in the Pond. Instead, EPA is simply seeking to impose a predetermined remedy and is relying on the curtailed sixty-day comment period to act as if it has satisfied its obligation under CERCLA to consult with the community in deciding upon a remedial approach.

B. EPA's Human Health and Ecological Risk Assessments Are Arbitrary, Capricious, and Otherwise Not In Accordance With Law

The suite of remedies selected by EPA in its Proposed Plan is grossly disproportional to any putative harm identified by EPA to humans or the environment. In fact, after sixteen years of extensive and laborious testing and analysis, the EPA has identified only two areas that it asserts pose a *current* health risk to humans—certain sediments in the Wells G&H Wetlands and in one location in the former Cranberry Bog—and these conclusions are based on ingestion scenarios that are simply not credible. To illustrate, EPA hypothesizes that people will fight through inhospitable vegetation to descend into and eat the mud in specific areas of highest concentrations repetitively for up to 104 times per year starting at age 1 and continuing for up to 24 years. Based on this hypothesis, EPA concludes that the sediments in those limited sections of the wetlands and bog will pose an unacceptable risk that must now be prevented at great expense and risk. These patently absurd exposure scenarios were the subject of comments of Gradient Corporation submitted on October 13, 2003 with respect to the Baseline Human Health Risk Assessment Report. Those comments were rejected out of hand by EPA in its "Responses" of June 28, 2004, without factual or scientific analysis and with no evidentiary support for the exposure scenarios whatsoever. SMC refers EPA to the comments of Gradient Corporation submitted along with SMC's comments. Gradient's comments demonstrate that EPA's current human health risk assessment is arbitrary, capricious, and otherwise not in accordance with law.

Putative *future* human health risks are equally implausible, based on exposure scenarios that are also unrealistic. Moreover, any putative future human health risks, which SMC denies, readily could be obviated by institutional controls, with the cooperation of the City of Woburn, local landowners, and PRPs. Indeed, Woburn's redevelopment plan already has taken this course, as EPA acknowledges. See page 11, below. SMC continues to rely on, and reiterates herein, the prior comments of Gradient, as well as Gradient's supplemental comments submitted herewith.

The only ecological harm identified by EPA consists of an alleged ecological risk to benthic invertebrate organisms (worms) in the HBHA Pond—a man-made flood control project that was never designed, and never served, as an ecological habitat. EPA's proposed remedy for the Pond assumes, erroneously, that dredging the Pond will restore a benthic community to the sediments of the Pond. It will not. As explained more fully in the attached Combined Comments and Alternative Remedial Action Plan, the anoxic nature of the Pond ensures that *a benthic community will never thrive in the deep portions of the Pond*, regardless of the level of contaminants found there. To the extent EPA genuinely seeks to restore a benthic invertebrate community—which SMC questions due to the remedy proposed by EPA for the HBHA Pond, which is grossly disproportional to this identified risk, as discussed below—a sounder course would be to create an alternative habitat elsewhere, in a location that is far more hospitable to such organisms than the HBHA Pond ever will be. The fact that EPA proposes to go much further than this with respect to the Pond, however, suggests that harm to a putative benthic invertebrate community in the bottom of the Pond is a pretext for other goals that EPA seeks to achieve in altering the Pond—goals which are not specified by EPA in the RI, FS, or Proposed Plan.

C. EPA's Proposed Remedy for the HBHA Pond is Arbitrary, Capricious, and Otherwise Not In Accordance With Law

1. EPA's Proposed Remedy for the HBHA Pond Will Disrupt the Natural Ability of the Pond to Sequester Arsenic, and Will Create Flooding Problems Downstream

As mentioned earlier, EPA's chosen remedy for the HBHA Pond is particularly costly, and is based upon a meaningless assessment of ecological risk. What is worse, EPA's preferred remedy fails to appreciate adequately that the Pond now acts as an extremely effective "sink" for arsenic and other contaminants. Iron-rich sediments currently in the Pond are very effective at adsorbing arsenic. EPA's proposal to dredge the Pond will impair the ability of the sediments to continue to act as an arsenic sink. By proposing radical changes to the flow and chemistry of the Pond, EPA's approach will impair the ability of the Pond to function as an effective retention device for contaminants. For a more detailed discussion, SMC refers EPA to the Combined Comments submitted herewith. As discussed in the Combined Comments, EPA's Proposed Plan for the Pond, rather than preventing the breakdown of the chemocline, could actually *cause* the breakdown of the chemocline. EPA has not studied the effects of its Proposed Plan on the chemistry and flow of the Pond. EPA's quixotic approach, therefore, does not aid the benthic community supposedly endangered within the Pond, and it will impair the contaminant-sequestering feature of the Pond. EPA's analysis of the HBHA Pond and Wetlands is not sufficiently well-defined.

Moreover, EPA's proposed remedy for the Pond could prove deleterious in terms of flood control in the area. As mentioned earlier, had EPA consulted with the Army Corps of Engineers, it could have received input from the Corps on how to address the Pond in a manner that would not exacerbate flooding downstream. In choosing a remedy for the HBHA Pond, EPA should preserve, to the maximum extent possible, the natural flow and chemistry of the Pond. Although SMC does not believe that a remedy is necessary, if EPA concludes otherwise, a storm-water system that continues to prevent the breakdown of the chemocline within the Pond during storm events would be a more effective remedy than what is currently proposed. The approach proposed by SMC in the attached Alternative Remedial Action Plan would allow the chemocline to remain effective at trapping arsenic and other contaminants year-round, while enhancing the flood-control features of the Pond.

2. EPA's Partial Dredging Remedy for the HBHA Pond Does Not Comply Adequately with ARARs, While a Subaqueous Permeable Reactive Cap Alternative Would Comply Fully with ARARs

In the FS, EPA posits that both HBHA-3 (Subaqueous Cap) and HBHA-4 (Storm Water Bypass and Sediment Retention with Partial Dredging and Providing an Alternative Habitat) comply with Applicable or Relevant and Appropriate Requirements ("ARARs") of Federal and State law.[3] Feasibility Study at 4-60. Later in the FS,

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[3] Any remedy selected by EPA under CERCLA must comply with any and all "legally applicable" or "relevant and appropriate" requirements ("ARARs") of Federal and State law with respect to the contaminant, the location of the site, and the action taken to remove or contain the contaminant, 42 U.S.C. § 9621(d)(2)(A); 40 C.F.R. § 300.430(e)(9)(iii)(B), (f)(1)(i)(A), unless there are grounds for a waiver of such

however, EPA acknowledges that the subaqueous cap complies with all applicable ARARs more effectively than does the partial dredging remedy. *Id.* tbl. 4-28D; *see also* Proposed Plan tbl. 4-29. Unlike dredging, a Subaqueous Permeable Reactive cap complies completely with chemical-specific ARARs for the Pond, because the cap would ensure that the discharge of arsenic from the groundwater does not make its way into the surface water of the Pond. A Subaqueous Permeable Reactive cap, proposed in SMC's Alternative Remedial Action Plan, achieves complete compliance with identified ARARs, while the dredging remedy does not.

Furthermore, EPA's dredging will contravene an action-specific ARAR identified by EPA for the Pond, namely a Massachusetts water pollution control regulation, which states that

> No discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less

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requirements, 42 U.S.C. § 9621(d)(4); 40 C.F.R. § 300.430(f)(1)(ii)(C). "Applicable requirements" are defined by the National Contingency Plan as

> [T]hose cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.

40 C.F.R. § 300.5. "Relevant and appropriate requirements" are defined as

> [T]hose cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

Id.

> adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

Mass. Regs. Code tit. 314, § 9.06(1). Obviously, insofar as a Subaqueous Permeable Reactive cap does not entail any discharge of dredged material, it does not offend this provision, as the dredging remedy will. EPA may respond that the subaqueous cap would not have "less adverse impact" upon the ecosystem of the HBHA Pond vis-à-vis dredging. *See* Feasibility Study tbl. 4-16B. As mentioned earlier, however, dredging will do nothing to restore a benthic invertebrate or aquatic community to the Pond, because the design and anoxic nature of the deep surface water and sediments of the Pond make the Pond inhospitable to benthic invertebrates and fish, *regardless* of the presence of arsenic and/or benzene. The subaqueous cap, as with the dredging remedy, will have no adverse impact on the aquatic ecosystem of the Pond, because neither option will succeed in creating a viable fish or worm habitat within the Pond, which was meant to be a storm-water retention device, not a habitat for aquatic life. Therefore, a Subaqueous Permeable Reactive cap should be preferred over the costly and disruptive dredging remedy, which is disfavored under Massachusetts environmental regulations.[4]

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[4] *The dredging remedy, which proposes to remove approximately 6,200 cubic yards of* sediment from the Southern portion of the Pond in an attempt to create a worm habitat in a Pond that is inhospitable to benthic organisms, regardless of the presence of contaminants, also raises serious questions about whether the remedy is cost-effective as required by the Massachusetts Contingency Plan. *See* Mass. Regs. Code tit. 310, § 40.0860(7) (stating that any proposed remedial action for the cleanup of contaminants does not justify the cost of the action if the cost is "substantial and disproportionate to the incremental benefit of risk reduction," or if it destroys more than 5,000 square feet of wetlands or wildlife habitat, other feasible alternatives exist, the contaminants at issue do not bio-accumulate and are not likely to migrate, and the damage to natural resources from the implementation of the proposed action would be permanent and irreparable).

D. *EPA's Proposed Remedy for the Near-Shore Sediments of the Wells G&H Wetlands and the Former Cranberry Bog is Arbitrary, Capricious, and Otherwise Not In Accordance With Law*

1. EPA's Sediment Remedy Is Needlessly Invasive, and Would Create Greater Human Health Risk Than Capping and Institutional Controls

The Wells G&H Wetlands and the Former Cranberry Bog, when properly analyzed, do not pose unacceptable risk to human health. For a detailed discussion of EPA's flawed exposure scenarios, SMC refers EPA to the reports of Gradient, submitted herewith. EPA's proposal to excavate near-shore sediments and dispose of them off-site is therefore totally unwarranted. Moreover, it would be less effective than the alternative of in-situ capping of these sediments, in conjunction with biological barriers (such as shrubs and thorn bushes) and other institutional controls, which would eliminate any real or imagined human health risks through ingestion of mud, without posing the present risk that dredging would entail. For further discussion, see the Alternative Remedial Action Plan, submitted herewith.

2. Contrary to EPA's Position, In-Situ Capping and Institutional Controls for Sediments Will Meet ARARs

EPA's remedy for the near-shore sediments of the Wells G&H Wetlands and the Former Cranberry Bog—removal and off-site disposal of approximately 2,300 cubic yards of sediment[5]—is based, in part, on an assumption that institutional controls and monitoring would not adequately comply with ARARs. *See* Feasibility Study tbl. 4-20D. As noted in Gradient's comments, however, EPA's exposure scenarios for sediments are

[5] Although this is EPA's preliminary estimate of the amount of sediment to be excavated, EPA states that "[a]ll near shore sediments exceeding the arsenic PRG will be excavated and transported offsite for disposal . . . ." Feasibility Study at E-18. The scope of EPA's excavation of the sediments is therefore inadequately defined at present, and could expand dramatically.

unrealistic. EPA ignores the facts that access to the near-shore sediments in these areas is well-nigh impossible, due to the dense vegetation in the area, and that even were an individual to gain access to the sediments, access does not translate into ingestion of the sediments on thousands of occasions over decades. To the extent that EPA's exposure scenarios are even remotely plausible, which they are not, further institutional controls, including but not limited to enhanced biological barriers (such as shrubs or thorn bushes), would be effective at impeding access to the Wells G&H Wetlands and the Former Cranberry Bog.

Ironically, EPA has dropped from its list of future areas of concern locations NT-1 and NT-2, precisely because the City of Woburn has decided not to build a boardwalk in that location, *see* Feasibility Study at 1-25, thus acknowledging implicitly the sufficiency of institutional controls. In fact, the City's Redevelopment Plan actually includes observation decks to *prevent* exposure to sediments, not facilitate it as EPA says. At page 128 of its Plan, the City says:

> The construction of observation decks would accommodate the viewing and enjoyment of the natural wetland area by the public, while allowing for the construction of a physical barrier, such as a storm fence or densely planted shrubbery, which would serve to keep the public away from the riverbank itself, and protect against direct exposure to contaminated sediments. This assumes, of course, that the soils in the upland area are not also a risk to human health.[6]

As noted earlier, dredging is a remedy that should be avoided if other, less invasive alternatives are equally effective at remediating the near-shore sediments of the Wells G&H Wetlands and the Former Cranberry Bog. *See, e.g.*, Mass. Regs. Code tit. 310, § 40.0860(7); *id.* tit. 314, § 9.06(1). EPA has given short shrift to the effectiveness

[6] EPA acknowledges that upland soils are not a part of the current or future risk to human health.

of institutional controls and monitoring by using unrealistic assumptions about ingestion of contaminants in the near-shore sediments of these two areas. Instead of resorting to excavation and off-site disposal, EPA should conclude that monitoring and institutional controls would suffice to prevent exposure to any contaminants residing in the near-shore sediments. If anything else were needed—and nothing else is—in-situ capping should be selected.

To the extent a waiver of ARARs is necessary with respect to the near-shore sediments of the Wells G&H Wetlands and the Former Cranberry Bog, EPA may consider capping and institutional controls to be an "interim measure" as part of a "total remedial action" that will satisfy ARARs, 40 C.F.R. § 300.430(f)(1)(ii)(C)(1), or an alternative that will attain an "equivalent" standard of performance to that required under the ARARs, *id.* § 300.430(f)(1)(ii)(C)(4). EPA should also consider whether the drastic remedy of excavation and off-site removal of sediments, the scope of which is inadequately defined, see footnote 5, may pose a greater risk to human health than institutional controls and monitoring, thus warranting a waiver of ARARs under 40 C.F.R. § 300.430(f)(1)(ii)(C)(2). Under any of these provisions, a waiver of ARARs would be appropriate, to the extent a waiver is necessary.

E. EPA's Proposed Remedy for the West Hide Pile Is Arbitrary, Capricious, and Otherwise Not In Accordance With Law

1. EPA's Proposal Ignores the Fact That Benzene Beneath the West Hide Pile Is Attenuating Naturally, and May Be Addressed Adequately with Existing Institutional Controls

With respect to the West Hide Pile, EPA's proposal to inject oxygen-releasing compounds into the benzene plume beneath the pile is entirely unnecessary, for several reasons. First, the benzene plume beneath the West Hide Pile is attenuating naturally.

EPA did not identify any human health or ecological risk that results from the benzene plume beneath the West Hide Pile. Second, the Custodial Trust, the passive landowner of the location with no ongoing operations, owns the land on which the West Hide Pile sits, and the Trust cannot allow the groundwater to be used for industrial or car wash purposes, as otherwise hypothesized by EPA; institutional controls, therefore, suffice. In fact, and most important, the interim Institutional Controls already chosen for the area preclude the use of groundwater. And under the final draft Grant of Environmental Restriction and Easement for the Industri-Plex Superfund Site (the "Grant"), the Restricted Activities and Uses for *all* classes of land include the following prohibited use:

> ii. extracting, pumping, consuming, exposing, or otherwise using groundwater, unless in strict compliance with the Work Protocols;

The Grant then goes on to identify Permitted Activities and Uses:

> iii. extraction and use of groundwater for the purposes of sampling monitoring wells, provided such extracted groundwater is disposed in accordance with applicable federal, state or local laws, regulations or ordinances.

EPA now ignores these Institutional Controls for the Site. It proposes remedial action in the area of the West Hide Pile as if the controls it has selected do not exist. Whether EPA forgot about, or simply chose to ignore, its prior action is unclear.

2. EPA's Proposal for the West Hide Pile Is Unnecessary to Comply with ARARs

EPA's Proposed Plan states that groundwater remedial option GW-2 (Pond Intercept with Monitoring and Institutional Controls), complies with all ARARs. Proposed Plan tbl. 4-29. Nevertheless, EPA proposes an addition to option GW-2 in the form of a modified version of GW-4, in-situ treatment of the groundwater beneath the West Hide Pile on the Industri-Plex Site, at an additional cost of $3.75 million, in complete disregard of the Institutional Controls specified in the Grant, which are referenced above.

Remedial option GW-4 is unnecessary to achieve compliance with ARARs for groundwater at the MSGRP Study Area. Remedial option GW-2, which combines a pond intercept mechanism with monitoring and institutional controls, already achieves compliance with ARARs, reduces the toxicity, mobility, and volume of contaminants, is less costly, and is significantly easier to implement than the in-situ groundwater treatment option. Proposed Plan tbl. 4-29.

Moreover, injecting oxygen-rich compounds into the groundwater beneath the West Hide Pile is not likely to diminish the size of the benzene plume, because other organic compounds will compete for the oxygenated material, thus preventing the material from targeting the benzene effectively. This proposal is therefore not only unnecessary, but fails to recognize that it is technologically impracticable to devise a system that will diminish the benzene plume by injecting oxygen into the groundwater beneath the West Hide Pile. In fact, injecting oxidizing material will lock up the iron in the groundwater, even though iron is needed to make the Pond work as an arsenic sink. Although SMC does not believe that injecting oxygenated compounds into the benzene plume is necessary to satisfy ARARs not already met by GW-2, if EPA disagrees, it should waive ARARs pursuant to 40 C.F.R. § 300.430(f)(1)(ii)(C)(3).[7]

[7] Alternatively, institutional controls and monitoring may be considered an "interim measure" that, along with the natural attenuation of benzene beneath the West Hide Pile, will become part of "total remedial action" that will meet ARARs. *Id.* § 300.430(f)(1)(ii)(C)(1). Or institutional controls and monitoring, along with natural attenuation, may be considered a remedial alternative that "will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach." *Id.* §

F. EPA's Monitoring Proposals Are Arbitrary, Capricious, and Otherwise Not in Accordance with Law

EPA's proposed monitoring appears to be an artifact of its adoption of multiple remedial activities, each with its own monitoring program, that have not been harmonized. For a more detailed discussion of this position, SMC refers EPA to the Combined Comments submitted herewith. The contemplated monitoring is unjustified, both in geographic and temporal slopes.

G. EPA's Suite of Remedial Options, Considered As a Whole, Is Arbitrary, Capricious, and Otherwise Not In Accordance with Law

All of these aspects of EPA's preferred remedy, and others discussed in the experts reports included herewith, demonstrate that EPA did not choose the most effective remedy, but instead chose a remedy that emphasized costly and ineffective options, among others, of dredging and excavation. EPA has been bound and determined—in fact, has announced publicly for years—that it will dredge the sediments from the Pond. Its remedy is simply in furtherance of this predetermined outcome, regardless of the fact that it is unnecessary, and may in fact make matters worse. EPA could achieve any true remedial objectives more effectively if it consulted with SMC, the Army Corps of Engineers, the City of Woburn, and other interested members of the community. EPA's failure to do so is arbitrary, capricious, and otherwise not in accordance with law.

For these and other reasons discussed herein, EPA's RI, FS, and Proposed Plan for the MSGRP Study Area are arbitrary, capricious, and otherwise not in accordance with law, and violate CERCLA. SMC reserves the right to supplement the record upon

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300.430(f)(1)(ii)(C)(4). In either instance, waiver of any applicable ARARs, to the extent waiver is required, which SMC does not concede, would be appropriate.

which EPA's final remediation decision is to be based, in view of the arbitrary brevity of the comment period. SMC further reminds the Agency that its cost recovery action pursuant to 42 U.S.C. §§ 9606 and 9607, filed in 1989, is still pending, and that the Court has retained jurisdiction over that matter. *See* Consent Decree, Art. XXX.

II. CERCLA IS UNCONSTITUTIONAL AS APPLIED TO STAUFFER

A. CERCLA Would Effect An Unconstitutional Taking of Stauffer's Property

Application of CERCLA to require Stauffer to participate in the cleanup of the MSGRP Study Area would effect an unconstitutional taking of property, in violation of the Takings Clause of the Fifth Amendment to the United States Constitution. Economic regulation like CERCLA, although it is not a "classic" instance of physical appropriation of private property for public use, may nonetheless effect a taking. *Eastern Enterprises v. Apfel*, 524 U.S. 498, 523 (1998) (plurality opinion). Here, in the event EPA orders Stauffer to undertake the Proposed Plan, it would permanently deprive Stauffer of private assets to further a public objective. In doing so, the Proposed Plan effectively shifts to one private party a disproportionate share of the cost of achieving a public end.

Three factors in particular demonstrate that CERCLA is unconstitutional as applied to Stauffer: "[T]he economic impact of the regulation, its interference with reasonable investment backed expectations, and the character of the governmental action." *Kaiser Aetna v. United States*, 444 U.S. 164, 175 (1979). Under the first factor, the economic impact of the regulation is substantial: EPA has proposed a remedy that will cost $25.7 million. Second, CERCLA severely interferes with Stauffer's investment-backed expectations. Stauffer owned the land that makes up the Industri-plex Site from 1935 to 1968, well before CERCLA was enacted in 1980. Stauffer's operations in no way involved the production or disposal of arsenic, the principal contaminant identified by EPA in the MSGRP Study Area. Imposing CERCLA liability for operations of Stauffer that ceased 22 years before the enactment of the statute, that were perfectly legal when they were performed, and for contamination that Stauffer did not generate, has a severe impact upon investment-backed expectations. Third, the nature of the government's action here is extraordinary: it seeks to pin on Stauffer (and perhaps a few other parties) a $25.7 million liability for conduct that may stretch back over 150 years, and that involves numerous parties that contributed to a putative harm that is not well-identified by EPA, and for which there is no proven cause. As the Supreme Court observed in *Eastern Enterprises*: "When [a statute] singles out certain [parties] to bear a burden that is substantial in amount, based on the [parties'] conduct far in the past, and unrelated to any commitment that the [parties] made or to any injury they caused, the governmental action implicates fundamental principles of fairness underlying the Takings Clause." *Id.* at 537.

B. CERCLA Constitutes Impermissible Retroactive Legislation That Violates Stauffer's Due Process Rights

In addition, the fact that EPA's proposed remedy under CERCLA reaches so far back into the past to impose so substantial a remedy violates Stauffer's substantive due process rights under the Fifth Amendment. *See generally Eastern Enterprises*, 524 U.S. at 547-550 (Kennedy, J., concurring in the judgment and dissenting in part). Retroactive legislation is generally disfavored. *Id.* at 547 ("[F]or centuries our law has harbored a singular distrust of retroactive statutes."); *id.* at 548 ("If retroactive laws change the legal consequences of transactions long closed, the change can destroy the reasonable certainty and security which are the very objects of property ownership."). CERCLA violates due process as applied to Stauffer because it seeks to impose liability for conduct that occurred over twenty years before the statute was enacted, for conduct that was legal when performed. *See Apfel*, 524 U.S. at 549 (Kennedy, J.) ("[I]n creating liability for events which occurred 35 years ago the [statute] has a retroactive effect of unprecedented scope.").

CONCLUSION

For all of the foregoing reasons, EPA's RI, FS, and Proposed Plan for the MSGRP Study Area are arbitrary, capricious, and otherwise not in accordance with law. To the extent EPA seeks to impose liability under CERCLA for activity of Stauffer decades ago that was legal when performed, CERCLA is unconstitutional.

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Dated: August 31, 2005

August 29, 2005

Joseph F. LeMay, P.E.
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Re: Comments on EPA Feasibility Study and Proposed Plan for Industri-Plex Site, for Areas South of Route 128, Woburn, MA.

Dear Mr. LeMay:

Gradient Corporation is submitting the following comments on behalf of Stauffer Management Company. The comments below are for the areas of the site located south of Route 128 in Woburn, and were prepared based on a review of the following documents:

- USEPA Region 1. May 2003. Baseline Human Health and Ecological Risk Assessment, Wells G&H Superfund Site OU-3, Aberjona River Study.
- Gradient Corporation. October 13, 2003. Comments on Baseline Human Health Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA. USEPA Region 1, March, 2003.
- USEPA Region 1. June 28, 2004. EPA responses to comments on the May 2003 Wells G&H Superfund Site OU-3 Aberjona River Study Baseline Human Health and Ecological Risk Assessment.
- USEPA Region 1. September, 2004. Baseline Human Health and Ecological Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA.
- Woburn Redevelopment Authority, Wells G&H Advisory Committee. February 2005. Wells G&H Superfund Redevelopment Initiative, Draft Land Use Plan.
- Draft Final MSGRP Remedial Investigation Report. Industri-Plex Site. Woburn, MA. March 2005.
- Draft Final Feasibility Study. Industri-Plex Site. Woburn, MA. June 2005.
- Proposed Plan for Industri-plex Superfund Site, Operable Unit 2 (including Wells G&H Operable Unit 3), Woburn, MA. June 2005.

In general, EPA's risk assessment overestimates risk in the Wells G&H wetland and the Cranberry Bog due to the use of overly conservative and unrealistic exposure assumptions. The exposure pathway responsible for most of the risk is the ingestion of sediment, however, visits to the wetland do not necessarily result in sediment contact or ingestion. The sediment contact frequency is too high for the visitor to the Wells G&H wetland and the Cranberry Bog, because the assumption fails to adequately consider the inaccessibility and lack of desirability of the sediments. The end result is that the calculated risks significantly overestimate the actual risks likely to be experienced

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by the local population. The impact of these over-estimates is a conclusion that remediation is required, when such remediation is unnecessary, because the use of more realistic (yet still conservative) exposure assumptions leads to risks that are within EPA's range of acceptable risk levels.

1. Gradient's October, 2003 Comments

Gradient provided a detailed analysis of the risks presented by exposures to sediments in the Cranberry Bog and the Wells G & H wetland as well as a revised probabilistic risk assessment (Gradient Corporation, October 13, 2003). At that time, we noted that if more plausible exposure assumptions are used for the wetland areas south of Route 128, there is no significant risk from exposure to sediments. We note that the comments provided in that prior analysis are still relevant, as EPA did not change the exposure assumptions in response to those comments, thus we continue to rely on our October, 2003 comments. EPA's response to comments noted that exposure frequencies of 104 days/year in the Cranberry Bog Conservation Area and 78 days/year in the Wells G&H wetland were based on professional judgment and were used to be conservative. However, EPA provided no supporting evidence that a child would actually enter the wetland to ingest sediment with this frequency. EPA's example of children playing paintball[1] at Wells G&H provided no evidence that children would enter the wetland itself. We reiterate that the frequency with which a receptor might enter the wetland and ingest sediment will be far less than the frequency with which he or she might visit an area to take a walk.

2. Risks in Wells G&H Wetland and Cranberry Bog Area

EPA found unacceptable risks due to exposure to arsenic in sediment in the Wells G&H wetland and the Cranberry Bog. The risk calculations are based on a exposure frequency of 104 days per year in the Cranberry Bog Conservation Area and 78 days per year in the Wells G&H wetland. In addition, the risk calculations assume that ingestion of and dermal contact with sediment occurs at this frequency every year for 6 years as a child, and 24 years as an adult. The frequency with which a receptor might contact sediment will be far less than the frequency with which he might visit an area to take a walk. The sediment exposure frequencies are too high because they do not reflect the fact that the Wells G&H wetland and the Cranberry Bog are poorly accessible and are unattractive and undesirable areas for wading.

EPA notes that they evaluated contact with "accessible" sediments, defined as "sediments present in areas of mild to moderate vegetation, of generally shallow (less than two feet) and slow moving surface water, with gradual banks, and/or less than 30 feet from shore" (page 1-25 of the FS). However, our earlier comments noted that it is difficult to access the sediment at stations WH and CB-03 due to the presence of dense vegetation, including vines and brambles. At some of the sample locations within station CB-03, it is necessary to descend a steep embankment covered in dense vegetation to access the sediment in the bog, which itself is densely filled with tall reeds. To access these points, we found that a 6-ft tall adult was waist-deep in brush. The three southernmost points at CB-03 appear to be located in an undesirable channel of stagnant water that is choked with decaying leaves, and to access these sample points, it is necessary to walk through a dense tangle of vines and brambles. For these reasons, it is highly implausible that a young child, ages 1 to 7 years

[1] EPA Responses to Comments on the May 2003 Wells G&H Superfund Site OU-3 Aberjona River Study Baseline Human Health and Ecological Risk Assessment, June 28, 2004, Attachment A, page 2.

old, would contact the sample locations at WH or CB-03 at all, let alone for 104 days/year. Even for a more plausible adolescent receptor, EPA's assumption that wading would occur 4 days/week for 6 months/year (104 days/year) at the Cranberry Bog, and 3 days/week for 6 months/year (78 days/year) in the Wells G&H wetland is a significant overestimate, due to the lack of accessibility and desirability of these areas.

EPA's response acknowledged the fact that some locations at CB-03 may be difficult to access by simply descending the bank, but noted they could be "easily accessed after entering the wetland in a less steep and drier area, and then traveling through the wetland to these sampling locations."[2] The fact that a child would have to walk through the soft sediment in the wetland to access these points, and could not access these points from the most direct route down the embankment, renders exposure to these locations implausible. Therefore, an exposure frequency of 104 days/year is too high and overestimates risk for this area.

The Woburn Redevelopment Authority Draft Land Use Plan for the Wells G&H area (February, 2005) includes a nature trail and two viewing platforms only in the upland areas, not in the wetland itself. Thus, it is highly unlikely that a young child would contact and ingest sediment with a frequency as high as 78 days/year in the future. The land use plan does not include plans for the interior wetlands represented by Station NT-1 (nature trail with wetland board walk) and NT-2 (nature trail with wetland pier). EPA therefore considered the sediment exposure pathways for NT-1 and NT-2 to be incomplete. Since the proposed nature trail is only in the upland area and does not extend into the wetland, the sediment exposure pathway at station NT-3 should also be considered incomplete. The Redevelopment Plan notes (p. 128) that the construction of observation decks would accommodate the viewing of the wetland by the public, "while allowing for the construction of a physical barrier, such as a storm fence or densely planted shrubbery, which would serve to keep the public away from the riverbank itself, and protect against direct exposure to contaminated sediments." Thus the proposed plan for the property does not envision repeated and ongoing sediment contact and ingestion by children. Due to the fact that no nature trail will be constructed in the wetland, an appropriate remedy for the Wells G&H wetland would be institutional controls.

Please feel free to give me a call if you have questions or comments.

Sincerely yours,

GRADIENT CORPORATION

Barbara D Beck

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Principal

[2] EPA Responses to Comments on the May 2003 Wells G&H Superfund Site OU-3 Aberjona River Study Baseline Human Health and Ecological Risk Assessment, June 28, 2004, Attachment A, page 2.

Comments on Baseline Human Health Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA, USEPA Region 1, March, 2003

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1 Overview

This report presents Gradient's comments on EPA's "Baseline Human Health Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA", dated March 2003. In general, we believe that EPA's risk assessment overestimates risk due to the use of several overly conservative and unrealistic exposure assumptions. The end result is that the calculated risks significantly overestimate the actual risks likely to be experienced by the local population. In this report we discuss the overly conservative nature of some exposure assumptions, and also show that the use of more realistic (yet still conservative) exposure assumptions leads to risks that are within EPA's range of acceptable risk levels.

Chapter 2 presents our specific comments on the text and appendices. The most problematic exposure parameters that have been overestimated include the exposure frequency, the sediment ingestion rate, and the exposure point concentrations, as discussed below.

- The exposure frequencies used by EPA were based solely on professional judgment. However, it is important to note that the frequency with which a receptor might contact sediment would be far less than the frequency with which he or she might visit an area to take a walk. The exposure frequencies have been overestimated because they do not reflect the fact that the Wells G&H wetland and the Cranberry Bog are unattractive and undesirable areas for wading. These areas are overgrown with 10-ft high reeds, have soft sediment, and have mosquitoes during the summer months. It is difficult to access the sediment at stations WH and CB-03 due to the presence of dense vegetation, including vines and brambles. At some of the sample locations in CB-03, it is necessary to descend a steep embankment covered in dense vegetation to access the sediment in the bog, which itself is densely filled with tall reeds. To access these points, we found that a 6-ft tall adult was waist-deep in brush. The three southernmost points at CB-03 appear to be located in an undesirable channel of stagnant water that is choked with decaying leaves, and to access these sample points, it is necessary to walk through a dense tangle of vines and brambles. For these reasons, it is highly implausible that a young child, ages 1 to 7 years old, would contact the sample locations at WH or CB-03 at all, let alone at the frequencies assumed by EPA. Even for a more plausible adolescent receptor, EPA's assumption that wading would occur 4 days/week for 6 months/year (104 days/year) at the Cranberry Bog, and 3 days/week for 6 months/year (78 days/year) in the Wells G&H wetland is a significant overestimate, due to the lack of accessibility and desirability of these areas. Even if a boardwalk were constructed at the Wells G&H wetland in the future, it is highly unlikely that a young child would leave the boardwalk to contact sediment with a frequency of 78 days/year. Moreover, it should be noted that a recent article in the Woburn Daily Times Chronicle (8/26/03) indicated that it is possible that no nature trail will be built in this area. EPA's overestimated exposure frequencies overestimate risk in these areas.
- EPA's assumption that a child obtains 50% of his daily soil/sediment ingestion from the site is based solely on professional judgment. Since soil ingestion is believed to occur sporadically throughout the day as a consequence of hand-to-mouth activity, the assumption that a child obtains 50% of his daily soil/sediment ingestion from the site implies that the child is ingesting sediment for a significant portion of the day. Since sediment in the Cranberry Bog and the Wells G&H wetland is difficult to access due to the dense vegetation, and the areas are undesirable as wading or play areas, the duration

of any sediment exposure event is likely to be very brief. Thus the assumption that a child obtains 50% of his daily soil/sediment ingestion from the site overestimates risk.

- Recent soil ingestion rate studies suggest that the average and high-end soil ingestion rates for children are lower than the values used by EPA (200 mg/day for a child and 100 mg/day for an adult) based on 1994 Region I Guidance. EPA's 1997 Exposure Factors Handbook recommends soil ingestion rates of 100 mg/day for a child and 50 mg/day for an adult (USEPA, 1997). Use of these soil ingestion rates would decrease risks by a factor of two.

- At several stations, EPA has based risks on a highly uncertain estimate of the average arsenic concentration that people might be exposed to, resulting in an overestimate of risk. The exposure point concentrations (EPCs) for several exposure areas (WH, CB-03, 13/TT-27) are highly uncertain and based on skewed data sets. This is especially problematic in that these datasets, as analyzed by EPA, yielded risks of potential concern. These stations are discussed below.

- At station WH, the dataset is highly skewed due to the inclusion of one sample with a high arsenic concentration. This sample (SD-12-01-ME with 3230 mg/kg) is the southernmost sample that EPA included in the WH area (Figure 1). The skewed dataset strongly suggests that this exposure area is not well delineated, and thus that this dataset may be inappropriate for use in risk management decisions. In addition, it is an unexpected observation that two samples with the same ID, taken by different contractors (SD-12-01-ME and SD-12-01-FW), appear to have been collected from two different locations (Figure 1).

- At station CB-03, on the western side of the Cranberry Bog, EPA used an arsenic EPC equal to the maximum concentration (1410 mg/kg) detected in this exposure area, because the 95%UCL exceeds the maximum concentration. EPA's use of the maximum concentration as the EPC indicates that the dataset for CB-03 is skewed, with the maximum concentration located at the southernmost sample (Figure 2). The sediment concentrations in 11 of the 12 samples at CB-03, ranging from 9.1 to 510 mg/kg, are much lower than the maximum concentration, and the average concentration of all 12 samples is only 272 mg/kg. Based on this dataset, if a person visited each sample location with equal frequency, then, on average, that individual would be exposed to an average concentration much lower than 1410 mg/kg. Therefore, using an EPC of 1410 mg/kg in all likelihood overestimates the risks for CB-03. In addition, the sediment in the CB-03 exposure area is not very accessible because these sample locations are located in areas with dense vegetation, including vines, brambles, and tall reeds.

- At station 13/TT-27, on the west side of the Wells G&H wetland, the dataset is highly skewed due to two samples with high concentrations. EPA used an arsenic EPC that is equal to the maximum concentration (4210 mg/kg) because the calculated 95%UCL exceeded the maximum. EPA's use of the maximum concentration as the EPC indicates that the 13/TT-27 area has too few samples to be well characterized. The skewed dataset strongly suggests that this exposure area is not well delineated, and thus that this dataset may be inappropriate for use in risk management decisions. The average concentration of all samples is 840 mg/kg. Based on this dataset, if a person visited each sample location with equal frequency, then, on average, that individual would be exposed to an average concentration that is much lower than 4210 mg/kg. Therefore, using an EPC equal to the maximum concentration of 4210 mg/kg likely overestimates risks for 13/TT-27.

EPA's uncertainty analysis should be expanded to more clearly articulate how many of the assumptions are biased towards overestimating rather than underestimating potential health risks. The impact of these conservative assumptions on the uncertainty in the calculated risks should be explained. In addition, as noted below in Appendix B, EPA's cancer slope factor for arsenic is very conservative, especially as applied to U.S. populations experiencing relatively low levels of exposure, and thus will further tend to overestimate the cancer risk from exposure to arsenic in sediment.

Chapter 3 presents the results of Gradient's deterministic risk calculations to demonstrate the implications of alternate (and more realistic) exposure assumptions for the risk estimates at Stations WH, NT-1, NT-2, NT-3, 13/TT-27, and CB-03. The exposure frequencies were reduced to 6 days/year, to reflect the fact that the Wells G&H wetland and the Cranberry Bog are very undesirable areas for wading, because they are covered in dense vegetation, including vines and brambles, and are difficult to access. In addition, the soil ingestion rates were reduced to the more recent values in EPA's 1997 Exposure Factors Handbook. The use of more realistic, yet still conservative, exposure assumptions results in deterministic RME cancer risks that are at or below $2x10^{-5}$ at all six of these stations. Noncancer risks are also at or below 0.4 at all six stations. These risks do not exceed EPA's permissible risk limits.

Chapter 3 also presents the results of Gradient's probabilistic (Monte Carlo) analyses. In order to assess the uncertainty associated with EPA's deterministic risk calculations, Gradient performed probabilistic risk calculations for the ingestion of arsenic in sediment, for current risk at CB-03, and future risk at stations WH, NT-1, NT-2, NT-3, and 13/TT-27. for both cancer and noncancer risks. Ingestion of arsenic in sediment is the major contribution to EPA's cancer and noncancer risks. The probabilistic risk calculations are presented to help put EPA's risks into perspective, and because USEPA Region I "considers Monte Carlo analysis to be an acceptable approach for analyzing uncertainty in the risk assessment" (USEPA, 1994).

The results of the probabilistic risk calculations indicate that all of the 95th percentile cancer risks are at or below $3x10^{-5}$. The 95th percentile risk is $1x10^{-5}$ at both WH and CB-03, $2x10^{-5}$ at NT-1, $6x10^{-6}$ at NT-2, $4x10^{-6}$ at NT-3, and $3x10^{-5}$ at 13/TT-27. The 95th percentile noncancer hazards range from 0.07 to 0.95 and are all less than EPA's acceptable hazard of 1.0. The 95th percentile risk means that there is a 95% probability that the risks to any one individual will be below this value.

The probabilistic risks are substantially lower than EPA's individual risk estimates for the ingestion of arsenic in sediment (Table 1). Although the probabilistic risks are only for the ingestion of arsenic in sediment, this pathway represents a major portion (about 75%) of EPA's total cancer risks for these stations. This analysis indicates that EPA's RME risks are very high-end values and hence are not representative of RME values. Use of a more plausible range of exposure inputs results in cancer risks falling within EPA's acceptable risk range of 10^{-6} to 10^{-4}, and noncancer hazards falling below 1.0.

Appendix A presents the results of recent soil ingestion rate studies to demonstrate that the sediment ingestion rates used by EPA overestimate likely sediment ingestion rates. EPA used RME sediment ingestion rates of 200 mg/day for a child and 100 mg/day for an adult, based on 1994 EPA Region I Guidance. EPA's 1997 Exposure Factors Handbook recommends soil ingestion rates of 100 mg/day for a child and 50 mg/day for an adult (USEPA, 1997). Use of these sediment ingestion rates would decrease predicted risks by approximately a factor of two.

Appendix B presents a discussion of arsenic toxicity to illustrate the very conservative nature of the arsenic toxicity factor, especially as applied to US populations, and provides evidence that the use of this factor will tend to overestimate the cancer risk from exposure to arsenic in sediment. Appendix B discusses U.S. epidemiological studies of arsenic carcinogenicity, demonstrating that the estimated arsenic exposures to sediment in the Aberjona River are well below the exposures experienced by U.S. populations where epidemiological studies have not found elevated cancer risks. In addition, the estimated arsenic exposures to sediment in the Aberjona River are well below the exposures found in studies of non-U.S. populations that show an increased risk of cancer due to exposure to high concentrations of arsenic in drinking water. Appendix B also discusses the implications of the non-linearity of the dose-response relationship for arsenic carcinogenicity, and the fact that exposure to arsenic in soil has not been shown to cause adverse health effects.

2 Specific Comments on Text and Appendices

Gradient's specific comments on the risk assessment report are presented below by report section and page number.

3.1.2 Identification of Exposure Stations

p. 3-8, 1st ¶. The exposure assumptions at NT-1, NT-2, and NT-3 are implausible. The NT-3 exposure area is a proposed nature trail on the eastern side of the wetland, near Well H, without access into the wetland. NT-2 includes the proposed NT-3 nature trail area, *plus* a pier extending west into the wetland. NT-1 includes the proposed NT-3 nature trail area, *plus* an elevated walkway located farther west in the wetland. The future RME cancer risks at NT-3, NT-2, and NT-1 are calculated by EPA as 1E-04, 2E-04, and 5E-04, respectively. Area NT-3 has an acceptable cancer risk of 1E-04. The cancer risks increase to what EPA concludes to be unacceptable levels (greater than 1E-04) with the addition of the pier (NT-2) and the elevated walkway (NT-1) that extend farther west into the wetland. Both the pier and the elevated walkway (boardwalk) would need to be elevated a few feet off the ground in order not to be subject to flooding. Thus, in order for a child (1 to 6 years old) to be exposed to sediment, he or she would have to leave the boardwalk and engage in activity bringing him or her in contact with sediments on each visit to the boardwalk. This is an implausible assumption given the young age of the children, and the fact that children of this age would be under supervision. It is unlikely that children would be allowed to leave the boardwalk, especially on each visit, and particularly if the area adjacent to and below the boardwalk is filled with dense vegetation.

For the exposure stations on the east side of the Wells G&H wetland, EPA used an exposure frequency of 78 days/year, based solely on professional judgment. However, an exposure frequency of 78 days/year (3 days/week for 6 months/year) is unrealistically high given the fact that this portion of the wetland is located immediately adjacent to the shooting range of the rod and gun club, the wetland is filled with reeds, the sediment is soft, and the area has mosquitoes during the summer months. These attributes would render the area unattractive as a wildlife viewing or recreational area. We also note that exposures to sediment do not occur unless the person leaves the path or boardwalk. EPA has blurred the distinction between how often someone visits the area to take a walk, and how often he or she might actually contact sediments by wading. Because the wetland lacks desirability as a play area, a person is unlikely to contact sediment each time he or she visits the area to take a walk. EPA's scenario implies that a child would ingest sediment during each of his or her 78 visits per year. This assumption is unrealistic, even for a reasonable maximum exposure scenario.

3.2.2.5 Data Evaluation

p. 3-16. Data Evaluation. The Aberjona River floods periodically. EPA should explain the basis for its implied assumption that samples collected in 1995 are still representative of current conditions, *i.e.*, whether EPA has evaluated co-located samples to show that 1995 and 2001 samples have similar concentrations, or whether EPA has studied the temporal variation in arsenic sediment concentration over time.

p. 3-17, 2nd ¶, 1st sentence. Cr(VI) was not detected in a sample with total chromium of 930 mg/kg, but was detected in a sample with total chromium of 13,400 mg/kg. On this basis, EPA assumes Cr(VI) is not present at sediment concentrations equal to or less than 930 mg/kg, and that Cr(VI) is present at 0.13% of the total chromium concentration at sediment concentrations greater than 930 mg/kg. This sentence should make it clear that the estimate of 0.13% of Cr(VI) is based on only one sample with a total chromium concentration of 13,400 mg/kg. This is a very conservative assumption, since the sample with Cr(VI) detected (13,400 mg/kg) has a concentration two orders of magnitude higher than the next highest concentration sample where Cr(VI) was not detected (930 mg/kg). Based on the observation that Cr(VI) was only detected in a sample with total chromium concentration of 13,400 mg/kg, EPA should apply the Cr(VI) assumption only to samples that have concentrations of total chromium greater than 10,000 mg/kg, as there is no justification for a broader application of this assumption.

p. 3-17, 3rd ¶, 2nd sentence. EPA states that "stations NT-2, NT-3 and WG have *station-specific* results demonstrating that Cr(VI) was non-detect at the location of the *maximum* detected total chromium value". The maximum concentration of total chromium at all three of these stations was 2570 mg/kg, in sample SD-WG-10. However, the report does not present Cr(VI) results for a sample with a total chromium concentration of 2570 mg/kg. EPA also implies (in the first paragraph on page 3-17) that there are no Cr(VI) results for total chromium concentrations between 930 and 13,400 mg/kg. Moreover, Appendix C.4 does not contain Cr(VI) results for any samples with total chromium concentrations between 930 and 13,400 mg/kg. Therefore the basis for the statement regarding station-specific Cr(VI) results for samples at stations NT-2, NT-3, and WG is unclear. If EPA has Cr(VI) data for samples with total Cr concentrations between 930 and 13,400 mg/kg, then these data should be presented.

p. 3-17, last ¶. The assumption that all chromium in surface water, surface soil, and fish exists as Cr(VI) has no scientific basis and is unrealistically conservative. It is not reasonable to assume that chromium in surface water exists entirely as Cr(VI) when EPA's data show that most of the chromium in these sediments exists as Cr(III).

3.2.3 Identification of COPCs

p. 3-19. It should be noted that the use of residential soil PRGs as a COPC screening criterion for surface soil along the streambank is very conservative. The level of exposure in residential scenarios is well above what is contemplated for recreational exposures. Similarly, using drinking water PRGs as a COPC screening tool for evaluating surface water in the Aberjona River, which is not used as a source of drinking water, is overly conservative.

p. 3-19. The AWQC for arsenic should not be used as an ARAR. The AWQC was derived using a toxicity value for inorganic arsenic. The majority of arsenic in fish exists as arseno-sugars (*e.g.*, arsenobetaine, arsenocholine). The fraction of inorganic arsenic in freshwater fish has been reported to be less than 10% (Schoof *et al.*, 1999). The arseno-sugars are essentially non-toxic because they are excreted unmetabolized in a relatively short time. EPA is currently revising the AWQC for arsenic based on this information (*Fed. Reg.* Oct. 12, 2000). In addition, the arsenic AWQC is more than 500 times lower than the maximum contaminant level (MCL), the regulatory limit for arsenic in drinking water that is based on a lifetime of daily exposure.

p. 3-20. EPA notes that the background fish tissue lead level is 0.34 mg/kg but then delays use of this value until the risk characterization. Lead should be eliminated as a COPC for fish tissue at this stage by comparison to background.

3.2.4 Determination of Exposure Point Concentrations

p. 3-22. Exposure Point Concentrations.

Gradient is unable to reproduce the EPC calculations for stations NT-1 and 13/TT-27 because the database provided by EPA[1] does not include some of the samples that EPA used in their exposure areas (according to Table C.1-1). At NT-1, seven samples are missing, and at 13/TT-27, one sample is missing.

EPA states (p.3-22, 2nd ¶) that "USEPA requires the use of the 95%UCL on the arithmetic mean concentration for the estimation of both the CT and RME risk", and notes that wherever possible, the 95%UCL has been used as the EPC. This discussion is misleading and should be modified for clarification and consistency with current guidance. EPA should cite their current guidance on calculating EPCs (USEPA, 2002).[2] The 2002 guidance recommends the use of the 99% Chebyshev UCL for certain datasets, and in fact EPA has used the 99% Chebyshev UCL as the EPC for certain datasets. Therefore discussing the use of only the 95% UCL in this discussion is incorrect. In addition, Table 3-3.2, which lists the statistic used for the EPC in each exposure area, is incorrect, because for stations where the EPC is the 99% Chebyshev UCL (for example, at WH), the table states that the 95%UCL was used. Table 3-3.2 should be corrected.

The EPC (and hence the risk) in the WH exposure area is heavily influenced by the samples that EPA chose to include in this exposure area. EPA selected the boundary of the WH exposure area, presumably based on professional judgment. However, EPA has not demonstrated that all of the sample locations they included in the WH exposure area are uniformly accessible. The arsenic EPC of 1900 mg/kg for the WH exposure area is heavily influenced by EPA's inclusion of one sample with a very high arsenic concentration (SD-12-01-ME). The WH samples (WH-01 to WH-10) included in the WH exposure area range from 4.7 to 424 mg/kg, and have an average arsenic concentration of 123 mg/kg. However, the last sample included in the WH exposure area, SD-12-01-ME, has a concentration of 3230 mg/kg, which is an order of magnitude higher in concentration than the next highest WH sample. This sample is the southernmost sample within this exposure area (Figure 1). Including this sample yields an EPC for station WH that is potentially biased high. If EPA did not include sample SD-12-01-ME in the WH exposure area, the EPC at WH would be 663 mg/kg[3], and risks at WH would decrease by a factor of 3. Thus, the inclusion of this one sample tends to overestimate the risk for the entire WH exposure area.

At station WH, the EPC of 1900 mg/kg is the <u>99%</u> Chebyshev minimum variance unbiased estimate (MVUE) UCL. Table 3-3.2 should note that the EPC for WH is the 99%UCL, not the 95%UCL, and EPA should provide the statistical rationale for using the 99% Chebyshev UCL as the EPC, as described in their 2002 guidance. EPA's use of the 99% Chebyshev UCL indicates that this dataset is highly skewed due to the inclusion of sample SD-12-01-ME. The skewed dataset strongly suggests that this exposure area is not well delineated, and thus that this dataset may be inappropriate for use in risk management decisions.

EPA has not provided sufficient information in their UCL guidance (USEPA, 2002) or ProUCL manual (USEPA, 2003) to assess the validity of their choice of the 99% Chebyshev UCL as better than other possible methods. EPA should provide its underlying analyses that led to the UCL recommendations so that experts in the community can review and refine if appropriate. For example, Saranko and Tolson (2003) (provided in Appendix C) show that the UCL of data sets with statistical characteristics similar to the WH dataset may be better estimated with alternative methods that give rise to lower UCL values. Their analysis suggests that EPA's method may have overestimated the EPC, and therefore the risk, for the WH dataset.

[1] Metcalf & Eddy (Wakefield, MA). 2002. "Analytical data for baseline risk assessment, Wells G&H Superfund Site, Aberjona River study, Operable Unit 3, Woburn, Massachusetts." February.

[2] USEPA, 2002. Office of Emergency and Remedial Response (Washington, DC). "Calculating upper confidence limits for exposure point concentrations at hazardous waste sites. Supplemental guidance to RAGS." OSWER Directive 9285.6-10. December. Downloaded from: http://www.epa.gov/superfund/programs/risk/ragsa/ucl.pdf.

[3] The EPC of 663 mg/kg was obtained from the ProUCL program, and is the 99% Chebyshev (MVUE) UCL.

At Station CB-03, on the western side of the Cranberry Bog, EPA used an exposure point concentration (EPC) that is equal to the maximum concentration (1410 mg/kg) detected in this exposure area, because the calculated 95%UCL exceeded the maximum. EPA's use of the maximum concentration as the EPC indicates that the CB-03 area has too few samples to be well characterized. The sediment concentrations in 11 of the 12 CB-03 samples are much lower, ranging from 9.1 to 510 mg/kg, and the average concentration of all 12 CB-03 samples is only 272 mg/kg. Based on this dataset, if a person visited each sample location with equal frequency, then on average, he or she would be exposed to an average concentration that is much lower than the EPC of 1410 mg/kg. Therefore, using an EPC equal to the maximum concentration of 1410 mg/kg likely overestimates the risks for CB-03.

At station 13/TT-27, on the west side of the Wells G&H wetland, EPA used an EPC that is equal to the maximum concentration (4210 mg/kg) detected in this exposure area, because the calculated 95%UCL exceeded the maximum. EPA's use of the maximum concentration as the EPC indicates that the 13/TT-27 area has too few samples to be well characterized. Seven of the nine samples used to characterize this area have arsenic concentrations ranging from 12 to 356 mg/kg, but the last two samples have concentrations of 2480 and 4210 mg/kg, respectively. The average concentration of all samples is 840 mg/kg. Based on this dataset, if a person visited each sample location with equal frequency, then, on average, he or she would be exposed to an average concentration that is much lower than 4210 mg/kg. Therefore, using an EPC equal to the maximum concentration of 4210 mg/kg in all likelihood overestimates the risks for 13/TT-27.

p. 3-22. Two stations were evaluated that had only one sample to represent the exposure area, stations AM and TT-30. It is not clear why these areas were evaluated as separate exposure areas with only one sample. The risks from these areas are highly uncertain.

p. 3-22, 3rd ¶. The following statement is incorrect and should be corrected: "In cases where the arithmetic mean value exceeded the maximum detected value, the maximum detected value was used as the EPC for both the RME and CT cases". It is not mathematically possible for the mean to exceed the maximum detected value (because the mean is an average of the maximum and at least one lower value). The sentence would be correct if "95%UCL" were substituted for "arithmetic mean value".

3.3 Exposure Assessment

p. 3-26, 1st ¶. The age of the child receptor is 1 to 6 years of age (p. 3-26). It is highly implausible that a child this young would have exposure to sediment with the frequency noted by EPA for the various scenarios, due to the fact that the wetlands are undesirable areas for wading, and are difficult to access by a small child due to the presence of dense vegetation both in and around the wetland. It is also implausible that a child would be exposed to sediment over his face, forearms, hands, lower legs, and feet on each and every exposure event, as EPA has assumed (p. 3-34).

p. 3-28, 2nd ¶. It could be better described that NT-3 is a subset of both NT-1 and NT-2, so that it is clear that these exposure areas overlap.

p. 3-28. The frequency with which an individual might go wading and contact sediment is much less than the frequency with which a receptor might *visit* a given exposure area, because the Wells G&H wetland and the Cranberry Bog are undesirable areas for wading. Both the Wells G&H wetland and the Cranberry Bog have very low desirability for wading because to access the wetland, one must walk through dense vegetation including vines and brambles, and the wetland itself is densely filled with reeds, the sediment is soft, and the area is filled with mosquitoes during the summer months. Although a person might walk along the path on the west side of the Cranberry Bog a few times per week, that individual might never contact sediment. Due to the lack of desirability of the Wells G&H wetland for wading, it is highly unlikely that a child who walks along a boardwalk in the future Nature Trail area would leave the boardwalk and contact sediment with a frequency of 78 days/year. Moreover, it should be noted that a recent article in the Woburn Daily Times Chronicle (8/26/03) indicated that it is possible that no nature trail will be built in this area. EPA should provide a basis for their assumptions and should support their exposure frequencies by providing information regarding observations of adults or children wading in sediment during any of their site visits.

p. 3-30 2nd ¶. The RME sediment ingestion rate of 100 mg/day for an adult and 200 mg/day for a child is particularly conservative. These values are based on 1994 Region I Guidance. However, EPA's 1997 Exposure Factors Handbook recommends soil ingestion rates of 100 mg/day for a child and 50 mg/day for an adult (USEPA, 1997). Use of these soil ingestion rates would decrease risks by a factor of two.

p. 3-30 3rd ¶. The adult exposure frequency ranges from 26 to 104 days/year, depending on the station. EPA states that due to the presence of shallow surface waters, wading is likely to be the primary recreational activity at stations along the river (p. 3-25). However, the frequency with which a receptor might go *wading* and contact and ingest sediment is much less than the frequency with which a receptor might *visit* an exposure area like the Cranberry Bog, to walk their dog, for example. We believe that the exposure frequencies used by EPA are too high, because they reflect a high-end estimate of the number of potential *visits* per year, rather than the potential number of *wading and ingestion events* per year. The Wells G&H wetland and the Cranberry Bog are unattractive areas for wading because access to the sediment is through dense vegetation including vines and brambles, the wetlands are filled with tall reeds, the sediment is soft, and these areas have mosquitoes during the summer months. At the Cranberry Bog, a 6-ft tall adult was waist-deep in brush to access the sediment; and once in the sediment, he stood in 10-ft tall reeds. Thus it is unreasonable to assume that a 1-7 year old child would contact sediment in the bog on a regular basis. It is also unreasonable to assume that wading and sediment contact activity would occur with a frequency as high as 4 days/week for 6 months/year at the Cranberry Bog, or 3 days/week for 6 months/year at the proposed future nature trail areas (NT-1, NT-2, NT-3).

3.3.2.2 Exposure Parameters

p. 3-32. EPA used an arsenic dermal absorption fraction of 3%, the default value recommended by EPA (USEPA, 2001a). This value is based on a study by Wester *et al.* (1993), where estimates of arsenic absorption ranged from 3.2 to 4.5 percent *in vivo* in monkeys. Various factors affect the efficiency of dermal absorption, and thus there is considerable uncertainty associated with this value. However, the 3% value is likely to overestimate arsenic absorption and thus overestimate risks for the following reasons:

- Wester *et al.* used a soluble form of arsenic (sodium arsenate) mixed with soil. However, the forms of arsenic found in sediment are likely to be relatively insoluble, since the arsenic has been present for decades, and the sediment is in contact with surface water.
- Wester *et al.* added sodium arsenate to moist soil, and applied the mixture to the skin; thus the arsenic was not "aged." However, in the environment, metals tend to transform to less soluble forms in soil over time, and can also become sequestered in the pores of soil particles (Loehr, 1996).
- Wester *et al.* applied soil to the abdominal skin of the animals for 24 hours, whereas a child receptor along the river might only be exposed to sediment *via* wading for a short period of time. Specifically, "...studies with 24-hour (or longer) exposure periods are likely to overestimate the degree of dermal absorption that would occur under typical human exposure conditions" (NEPI, 2000). The absorption of any material is time-dependent. To the extent that an individual washes his skin more often than once every

24 hours, the uptake will be reduced. Washing may remove any soil residues adhering to the skin before absorption can occur to the same extent as in the animal study.

- In the Wester study, no urinary arsenic measurements were collected within the first 24 hours; therefore, it is not possible to estimate the amount of arsenic absorbed in periods less than 24 hours. After 7 days, a total of 3.2% of the arsenic was absorbed from the soil high dose. After one day (*i.e.*, in the first 24 hours), a total of 1.2% of the arsenic was absorbed from the soil high dose. Thus, about 40% (1.2% ÷ 3.2%) of the total absorption from soil occurred in the first 24 hours. A child playing in sediment would be exposed to arsenic in sediment for less than 24 hours. Thus it is reasonable to assume that the child's dermal absorption of arsenic from sediment, even assuming an extremely conservative exposure period on the order of 2 hours, would be no more than 1.2%. For this reason, use of a dermal absorption value of 3% is conservative and would overestimate the amount absorbed and thus overestimate risk *via* the dermal contact pathway.

EPA should point out in the uncertainty section that use of a dermal absorption value of 3% overestimates the amount absorbed, possibly by a factor of two or more, and thus overestimates risk *via* the dermal contact pathway.

p. 3-32. EPA's assumption is that 50% of the fish consumed is obtained from the study area. EPA should support this assumption by providing data on the productivity of this river, types of food fish in the river, and whether the fish populations can support this rate of consumption. Support for the consumption rate is cited from EPA's Exposure Factors Handbook which states that approximately half of the total fish consumed in fishing households is obtained from recreational activities (USEPA, 1997). The implication is that 50% of the fish consumed comes from recreational activities, and that 100% of the recreational fishing occurs in the study area. The assumption that 100% of the recreational fishing for 24 years occurs in the same river is highly implausible. In reality, individuals are likely to fish in different locations over the span of 24 years as conditions in this and other fishing locations change over time.

3.4 Toxicity Assessment

p. 3-37. EPA's adjustments to the surface water RfD for manganese to account for dietary intake of manganese are overly conservative. Manganese presents a unique problem in that the level required for physiologic functioning is only slightly lower than the level where neurological effects are seen. Therefore, IRIS recommends taking into consideration dietary contributions of manganese when "using the reference dose to determine acceptable concentrations of manganese in water and soils" and suggests using a modifying factor of 3 for drinking water (IRIS, 1996). The IRIS modifying factor of 3 for drinking water also considers neonatal exposures. The IRIS RfD, without modification, is 0.14 mg/kg-day.

USEPA Region I guidance differs from the IRIS guidance. For drinking water exposures, USEPA Region I guidance advises adjusting the IRIS RfD to account for dietary intake (a 2-fold-reduction) and to account for neonatal exposures (a 3-fold reduction) (USEPA, 1996). This 6-fold reduction of the IRIS RfD results in a Region I RfD for drinking water of 0.024 mg/kg-day.

In this risk assessment, EPA has adjusted the manganese RfD for surface water according to the Region I guidance for drinking water. This is overly conservative, because surface water from the Aberjona river is not used as a drinking water source. Furthermore, neonatal exposures are not expected under the recreational exposure scenarios that EPA evaluated. For surface water, the IRIS recommendation of a 3-fold reduction of the RfD is more appropriate and still takes into account dietary intake and neonate exposures.

p. 3-38. It is unreasonable to assume that chromium in surface water exists entirely as Cr(VI) when EPA's data show that most of the chromium in these sediments (where the chromium in surface water originates) exists as Cr(III).

3.4.4 Toxicity Information for Arsenic in Sediment

p. 3-40. 1st ¶, last sentence. Oral bioavailability information is provided in Appendix C.8, but Table C.8-1 should be referenced to allow the reader to easily find the information.

p. 3-41. EPA describes the two bioavailability values derived from the swine study as a range of best estimate bioavailability values. EPA should state that these values represent the mean bioavailability values for two different sediment types.

p. 3-41. For the equation, the second RfD term should have the subscript "IRIS", not "IRIA".

3.4.5 Toxicity of Lead

p. 3-42, 1st ¶, 6th sentence. Blood lead levels are reported in units of micrograms per deciliter (μg/dL). Change 10 mg/dL [milligrams per deciliter] to 10 μg/dL. This sentence does not make sense in this context. The model was used to calculate a blood lead level, not a soil lead concentration.

p. 3-42, 2nd ¶, 3rd sentence. Change 10 mg/dL to 10 μg/dL. This sentence does not make sense in this context. The model was used to calculate a blood lead level, not a soil lead concentration.

p. 3-42, 4th and 5th sentence. Change mg/dL to μg/dL.

3.5.2.2 Description of ILCR Estimates

p. 3-48. It should be noted that the risk and hazard index estimates would decrease if a lower, more reasonable exposure frequency were used, particularly for stations in the Wells G&H wetland, which is an undesirable area for wading. Chapter 3 of this report presents revised risk calculations that show the effect of using a lower and more realistic exposure frequency.

p. 3-50, 5th and 6th sentence. Change mg/dL to μg/dL.

3.5.3 Description of Uncertainties

p. 3-51. The uncertainty analysis states that uncertainty exists for certain parameters, but does not note the steps that were taken to address the uncertainties in the risk assessment. In a conservative risk assessment such as this, many of the assumptions are biased towards overestimating potential health risks. The impact of these conservative assumptions on the uncertainty in the calculated risks should be explained.

p. 3-52, 2nd ¶. EPA states: "Conversely, the biodegradation of chemicals to more toxic chemicals was also not considered." The discussion of the biodegradation of chemicals should be clarified. There are two types of biodegradation that could be the subject matter here. Metabolism or biodegradation within the human body (and potential conversion of chemicals to more toxic metabolites) is accounted for in the studies that support the RfDs and CSFs. Biodegradation in the environment, prior to human exposure, is not accounted for in the toxicity values. However, most environmental processes transform chemicals towards less reactive, less toxic forms (*e.g.*, oxidation of double bonds, dechlorination, binding in complexes, *etc.*). Thus, although biodegradation of COPCs in the environment is not factored into the risk assessment, it is not likely to result in an underestimate of potential health risks.

p. 3-52, 3rd ¶, last sentence. EPA states that "...it is not expected that actual risks will be significantly greater than estimated risks". In fact, due to the extremely conservative screening approach employed (comparing maximum detected concentrations to screening values based on residential exposures), the added contribution of chemicals that were eliminated as COPCs would be negligible. The word "significantly" should be deleted.

p. 3-53. Section 3.5.3.3, Toxicological Data. This section should provide greater detail on the uncertainty and conservatism in the toxicity factor for arsenic, because arsenic is the major risk driver at this site. Appendix B to this report presents a discussion of arsenic toxicity.

p. 3-53., 2nd sentence. This sentence: "For the study area, there is a probability of overestimating health risks or hazards for a number of reasons..." does not appear to belong in the section on "Toxicological Data". This sentence should be moved to the first paragraph on p. 3-51.

p. 3-53. 2nd ¶. EPA states that "one of the major contributors to uncertainty is the accuracy of the toxicity values used." EPA gives several assumptions used in the dose-response model for carcinogens, and states that "to the extent that any of these assumptions are incorrect, the extrapolated risks may be over- or under-estimates." However, EPA should note that, in the derivation of toxicity values, conservative assumptions are made to account for these uncertainties, and thus the values tend to be biased towards overestimating risk. For example, humans are considered to be as sensitive as the most sensitive test species. In the case of arsenic, the major risk driver in this assessment, the toxicity factor is, as discussed in Appendix B, very conservative as applied to U.S. populations.

p. 3-53, 3rd ¶. The toxicity factors are conservative and contain uncertainty factors. Appendix B to this report discusses toxicological uncertainties for arsenic.

p. 3-54, 3rd ¶. The sixth sentence should be revised to: "The assumption that RME receptors <u>obtain</u> 100% of their <u>self-caught</u> dietary fish intake from the Aberjona River was also conservative."

p. 3-54. The EPC uncertainty section should make the following points:

The EPC (and hence the risk) in the WH exposure area is heavily influenced by the samples that EPA chose to include in this exposure area. EPA selected the boundary of the WH exposure area, presumably based on professional judgment. However, EPA has not demonstrated that all of the sample locations they included in the WH exposure area are uniformly accessible. The arsenic EPC of 1900 mg/kg for the WH exposure area is heavily influenced by EPA's inclusion of one sample with a very high arsenic concentration (SD-12-01-ME). The WH samples (WH-01 to WH-10) included in the WH exposure area range from 4.7 to 424 mg/kg, and have an average arsenic concentration of 114 mg/kg. However, the last sample included in the WH exposure area, SD-12-01-ME, has a concentration of 3230 mg/kg, which is an order of magnitude higher in concentration than the next highest WH sample. This sample is the southernmost sample within this exposure area (Figure 1). Including this sample yields an EPC for station WH that is potentially biased high. If EPA did not include sample SD-12-01-ME in the WH exposure area, the EPC at WH would be 663 mg/kg[4], and risks at WH would decrease by a factor of 3. Thus, the inclusion of this one sample tends to overestimate the risk for the entire WH exposure area.

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[4] The EPC of 663 mg/kg was obtained from the ProUCL program, and is the 99% Chebyshev (MVUE) UCL.

At station WH, the EPC of 1900 mg/kg is the 99% Chebyshev minimum variance unbiased estimate (MVUE) UCL. Table 3-3.2 should note that the EPC for WH is the 99%UCL, not the 95%UCL, and EPA should provide the statistical rationale for using the 99% Chebyshev UCL as the EPC, as described in their 2002 guidance. EPA's use of the 99% Chebyshev UCL indicates that this dataset is highly skewed due to the inclusion of sample SD-12-01-ME. The skewed dataset strongly suggests that this exposure area is not well delineated, and thus that this dataset may be inappropriate for use in risk management decisions.

EPA has not provided sufficient information in their UCL guidance (USEPA, 2002) or ProUCL manual (USEPA, 2003) to assess the validity of their choice of the 99% Chebyshev UCL as better than other possible methods. EPA should provide its underlying analyses that led to the UCL recommendations so that experts in the community can review and refine if appropriate. For example, Saranko and Tolson (2003) (provided in Appendix C) show that the UCL of data sets with statistical characteristics similar to the WH dataset may be better estimated with alternative methods that give rise to lower UCL values. Their analysis suggests that EPA's method may have overestimated the EPC, and therefore the risk, for the WH dataset.

At Station CB-03, on the western side of the Cranberry Bog, EPA used an exposure point concentration (EPC) that is equal to the maximum concentration (1410 mg/kg) detected in this exposure area, because the calculated 95%UCL exceeded the maximum. EPA's use of the maximum concentration as the EPC indicates that the CB-03 area has too few samples to be well characterized. The sediment concentrations in 11 of the 12 CB-03 samples are much lower, ranging from 9.1 to 510 mg/kg, and the average concentration of all 12 CB-03 samples is only 272 mg/kg. Based on this dataset, if a person visited each sample location with equal frequency, then on average, he or she would be exposed to an average concentration that is much lower than the EPC of 1410 mg/kg. Therefore, using an EPC equal to the maximum concentration of 1410 mg/kg in all likelihood overestimates the risks for CB-03.

At station 13/TT-27, on the west side of the Wells G&H wetland, EPA used an EPC that is equal to the maximum concentration (4210 mg/kg) detected in this exposure area, because the calculated 95%UCL exceeded the maximum. EPA's use of the maximum concentration as the EPC indicates that the 13/TT-27 area has too few samples to be well characterized. Seven of the nine samples used to characterize this area have arsenic concentrations ranging from 12 to 356 mg/kg, but the last two samples have concentrations of 2480 and 4210 mg/kg, respectively. The average concentration of all samples is 840 mg/kg. Based on this dataset, if a person visited each sample location with equal frequency, then, on average, he or she would be exposed to an average concentration that is much lower than 4210 mg/kg. Therefore, using an EPC equal to the maximum concentration of 4210 mg/kg likely overestimates the risks for 13/TT-27.

5.1.6 Baseline Human Health Risk Assessment

p. 5-9, 2nd ¶. The EPC is the 95% upper confidence limit on the mean concentration.

p. 5-10, last sentence. Change "are:" to "are arsenic and benzo(a)pyrene."

APPENDIX C-3 Human Health Reference Calculations

Table C.3-2.1. The AWQC for arsenic should not be considered for COPC screening. The AWQC was derived using a toxicity value for inorganic arsenic. However, the majority of arsenic in fish exists as arseno-sugars (*e.g.*, arsenobetaine, arsenocholine). The fraction of inorganic arsenic in freshwater fish has been reported to be less than 10% (Schoof *et al.*, 1999). The arseno-sugars are essentially non-toxic because they are excreted unmetabolized in a relatively short time. EPA is currently revising the AWQC for arsenic based on this information (*Fed. Reg.* Oct. 12, 2000).

Tables C.3-3.1, C.3-3.2, C.3-3.3. Arsenic, lead and mercury concentrations in wetland surface water are below their respective MCLs, meaning this water meets drinking water standards.

Table C.3-5. Regarding the primary target organ column, bis-2-ethylhexyl-phthalate is also a reproductive toxin in animals (only the liver is mentioned) and inorganic mercury is better known as a nephrotoxin than an immunotoxin. The primary target organ should not be listed as "NOAEL" for chromium (VI) and vanadium. The kidney is the primary target organ for chromium *via* oral exposure. The target organ for vanadium by oral exposure could be listed as "not known".

Table C.3-6. It should be stated in the notes that cadmium and chromium (VI) are recognized as carcinogens by the inhalation route of exposure but do not appear to be oral or dermal route carcinogens (IRIS, 2003).

APPENDIX C-5 Derivation of Allowable Daily Intake

General. Several calculations of allowable daily intake result in improbable values; either soil concentrations greater than 1 million mg/kg (*i.e.*, more than 100%) or fish tissue concentrations that are biologically implausible (*e.g.*, a fish composed of 10% magnesium). EPA should not use solutions that are not possible in real life. One million mg/kg should be used as the maximum soil concentration. A nominal cutoff value (*e.g.*, 1% or 10,000 mg/kg) should be used as the value in edible fish tissue when very high risk-based values are calculated.

p. C.5-1. The FDA Daily Recommended Value (DRV) for sodium is 2,400 mg/day. The soil value of 1,000,000 mg/kg equates to a block of pure salt.

p. C.5-2. The FDA Recommended Daily Intake (RDI) for calcium is 1,000 mg/day. EPA should indicate why a 10-fold reduction was not applied as was the case for sodium (presumably because excessive sodium intake is more of a health hazard than excessive calcium intake). The soil value of 4,000,000 mg/kg is greater than 100%. The fish value of 50,000 mg/kg would require that the edible fish tissue (*i.e.*, excluding bones and viscera) be 5 percent calcium, which is not possible.

p. C.5-3. The FDA RDI for magnesium is 400 mg/day. The soil value of 8,050,000 mg/kg is greater than 100%. The fish value of 100,630 mg/kg would require that 10% of the edible fish tissue be pure magnesium, which is not possible.

p. C.5-4. The FDA DRV for potassium is 3500 mg/day. The soil value of 1,000,000 mg/kg is equal to 100% potassium, which is not possible.

APPENDIX C-8 Toxicity Profiles for COPCs

General.

- Although the inhalation route of exposure is not being evaluated in this risk assessment, this section contains information on the toxicity of compounds *via* the inhalation route. This should be eliminated as confusing to the reader.
- The discussion and citation of RfDs and CSFs is inconsistent between chemicals, *i.e.*, for some chemicals these values are provided and for others they are not.

- Because inhalation exposures are not being evaluated, discussion of RfCs should be eliminated.
- Bis-2-ethylhexyl-phthalate is a COPC in the risk calculation tables, but there is no discussion of this compound in Appendix C-8.

p. C.8-2. The term q1* is outdated terminology. The term CSF (cancer slope factor) is currently in use.

p. C.8-5. IRIS lists the animal dose as 20 but the human equivalent concentration (HEC) as 14. These terms should be clarified.

p. C.8-10. It should be explained that there is no RfD for the carcinogenic PAHs because either RfDs are given for individual compounds, or there is an explanation for why the RfD is lacking. Change "factor" to "factors".

p. C.8-24. EPA should provide the absorption of PCBs through the skin and GI tract in a more quantitative manner. EPA should note that chloracne (like non-chemical acne) is only disfiguring if it is severe.

p. C.8-29. The statement in the toxicity profile that states that dermal absorption of arsenic is "not significant" contradicts the results in this risk assessment, in which dermal exposure to arsenic contributes 20-30% of the risk. In addition, arsenic is embryotoxic, fetotoxic and teratogenic only at doses and in some cases *via* routes which are inconsistent with plausible human exposures. See DeSesso in Teratology 2001 64(3):170-3.

p. C.8-31. The acutely toxic dose noted for barium should be put in units of mg (800 mg not 0.8 g) to make it more easily comparable to the other doses and the RfD which are expressed in mg.

p. C.8-32. The RfC for barium is not relevant to this assessment as inhalation route exposures are not being evaluated.

p. C.8-34. According to IRIS, the chronic oral RfD for chromium (VI) is 3E-3 mg/kg-day not 5E-3 mg/kg-day as stated in the text. According to IRIS, the chronic oral RfD for chromium (III) is 1.5 mg/kg-day not 1 mg/kg-day as stated in the text. The correct IRIS RfD for chromium (VI) was used in the calculations so this correction only affects the text, not the risk estimates.

p. C.8-34. EPA should state explicitly that chromium (VI) has not been shown to be a carcinogen by the oral route of exposure. While it is true, as stated, that ingested chromium VI is listed by USEPA as not classifiable as to carcinogenicity, the available data indicate a lack of tumorigenicity after oral chromium (VI) exposure. For example, a recent expert review panel report commissioned by the State of California indicated that chromium (VI) was not likely to be carcinogenic by the oral route of exposure (California Chromate Toxicity Review Committee, 2001). See also Proctor *et al.* (2002), and Zhang and Li (1997).

p. C.8-36. The discussion of copper hydroxyquinoline should be deleted because an organic copper compound like copper hydroxyquinoline is not relevant to an environmental copper exposure.

p. C.8-37. No RfD is identified for copper in this section although a value of 4E-2 mg/kg-day is used in the risk calculations. There is currently no RfD for copper listed on IRIS, although an MCL exists which is often used to derive an RfD. EPA should document the basis for the 4E-2 mg/kg-day value in the text.

p. C.8-39. The RfD for cyanide (2E-2 mg/kg-day) should not be included in this section, as cyanide is not a COPC for this risk assessment.

p. C.8-42. Although EPA has classified lead and lead compounds as a Group B2 probable human carcinogen, EPA has stated that the carcinogenic potency of lead appears weak and that risk management decisions based on lead's neurodevelopmental effects should be adequate to address possible carcinogenic effects. The statement should be made that it is EPA policy to evaluate lead for neurodevelopmental effects and not carcinogenicity. As written, it implies that carcinogenicity is not evaluated simply because a value is not available.

p. C.8-49. The discussion of the toxicity of nickel carbonyl should be deleted. This compound has a toxicity quite different from inorganic nickel, is an occupational chemical, and is not found at the site. The same applies to nickel subsulfide.

p. C.8-51. The first two sentences of the selenium discussion are out of place and add no significant information to the discussion. They should be deleted and the section should start with the next paragraph.

p. C.8-58. Some explanatory text should accompany Table C.8-1 because toxicity, not oral bioavailability, is the primary topic of the preceding 57 pages. The reason why other compounds (*e.g.*, PCBs, lead, organic mercury, *etc.*) are not listed should also be noted. Finally, the special case of the site-specific oral bioavailability of arsenic in sediment should be discussed.

APPENDIX C-9 Relative Bioavailability of Arsenic in Sediments from the Aberjona River

p. 3. EPA should provide more information on where the sediment samples were collected. For example, the location in the streambed and the depth of the overlying water column should be provided.

p. 17. This section should note whether any data were excluded from the analysis.

Figure 4-2. The data suggest two groups of results at high arsenic doses, one following linear dose-elimination pattern and one following a sublinear pattern. EPA should state whether the data following the apparent sublinear pattern represent a subgroup of animals, or if this is simply random variability in the data.

Figure 5-1. The RBA values in this figure appear to be approximately 54% and 43%. What do these values represent? Their arsenic concentrations seem to match sediment samples TM1 and TM2. However the RBA estimates provided for TM1 and TM2 on page 17 are 37% and 51%. EPA should add error bars to this figure so that the apparent dose-effect on RBA can be more clearly evaluated by the reader.

Table B-3. The footnotes indicate that some pigs ate only part of their dose. An estimate of the amount of the dose consumed is noted. However, if the soil is not homogeneous within the doughball but rather located in the center, EPA should explain whether it is possible to accurately estimate the amount of soil not consumed from the amount of dough not eaten.

3 Revised Risk Calculations

3.1 Revised Deterministic Risk Calculations

EPA's risk analysis overestimates risks due to a number of overly conservative exposure assumptions, including high-end estimates for exposure frequency and soil ingestion rate. EPA's assumptions for exposure frequencies, which are based on professional judgment, are especially troubling. For example, it is highly implausible that any individual, starting at age 1, would wade in the maximum concentration sediment at CB-03 for 4 days/week, 6 months/year, and 30 years. This section presents recalculated cancer and noncancer risks for WH, NT-1, NT-2, CB-03, and 13/TT-27, to show the impact of more plausible (yet still conservative) estimates for exposure frequency and soil ingestion rate. The changes to exposure frequency and ingestion rate are still conservative, but yield a more realistic estimation of risk.

Exposure frequencies were modified in the following manner:

- For current and future risks from exposure to sediment at the west side of the Cranberry Bog (CB-03), we assumed a sediment exposure frequency of 1 day/month for 6 months/year (6 days/year). The cranberry bog has little desirability as a wading area, because it is densely filled with reeds, it is accessible only by walking through dense vegetation that includes vines and brambles, it has mosquitoes present during the summer, and it shows little evidence that humans use this area on a frequent basis.
- For current risks from exposure to sediment at WH, we used an exposure frequency of 4 days/year. Like the Cranberry Bog, the Wells G&H wetland has little desirability as a wading area, because it is densely filled with reeds, it is surrounded by dense vegetation including vines and brambles, and it has mosquitoes present during the summer. For current exposures at WH, we used a lower exposure frequency than for the Cranberry Bog, because this wetland is currently even harder to access than the Cranberry Bog.
- For future risks from exposure to sediment at the stations in the Wells G&H wetland (WH, NT-1, NT-2, NT-3, and 13/TT-27), we used an exposure frequency of 1 day/month for 6 months/year (6 days/year), the same as that used for the Cranberry Bog. Future redevelopment may make accessibility to this wetland approximately equal to that of the Cranberry Bog, and this wetland is considered as undesirable for wading as the Cranberry Bog.

The soil ingestion rate was decreased to 100 mg/day for a child and 50 mg/day for an adult, using the recommended soil ingestion rates in EPA's Exposure Factors Handbook (USEPA, 1997). All other parameters were kept the same, including the EPCs, the 50% fraction from site, and the exposure duration.

Table 1 presents revised risks to illustrate the impact of two modest changes in exposure parameters. All revised risks are within EPA's acceptable levels for both cancer and noncancer risks. The current RME cancer risks at WH and CB-03 decrease to $8x10^{-6}$ and $9x10^{-6}$, respectively. The current RME noncancer risks at WH and CB-03 both decrease to 0.2. The future RME cancer risks at WH, NT-1, NT-2, and NT-3 decrease to between $4x10^{-6}$ and $2x10^{-5}$. The future cancer risk decreases to $9x10^{-6}$ at CB-03, and to $3x10^{-5}$ at 13/TT-27. The future RME noncancer risks decrease to 0.3 at WH and NT-1, 0.1 at NT-2 and NT-3, 0.2 at CB-03, and 0.4 at 13/TT-27. All risks are within EPA's acceptable exposure limits. Note that although we used an exposure frequency of 4 days/year for current risk, and 6 days/year for future risk, at stations in the Wells G&H wetland (WH, NT-1, NT-2, NT-3, and 13/TT-27), the exposure frequency could be as high as 15 days/year and risks would still fall within EPA's acceptable risk limits. The exposure frequency at CB-03 in the Cranberry Bog could be as high as 35 days/year and risks would still fall within EPA's acceptable risk limits.

Only two exposure parameters were modified for the revised risks presented in Table 1. However, other parameters could be modified that would reduce risks even further, such as use of a lower dermal absorption for arsenic, or use of a subchronic RfD for arsenic. Dermal contact accounts for 20-30% of the total risk for both cancer and non-cancer and is thus a significant contribution to risk. EPA used a dermal absorption of 3%. Using the results of the Wester study (see Section 3.3.2.2) it is reasonable to assume that a child's dermal absorption of arsenic from sediment, even assuming an extremely conservative exposure period on the order of 2 hours, would be no more than 1.2%. Thus the dermal absorption value of 3% is conservative and tends to overestimate the amount absorbed and overestimate risk *via* the dermal contact pathway. We note, in addition, that there is no literature to indicate that dermal contact with arsenic in sediment or soil causes cancer or any other health effects.

A subchronic RfD is appropriate for evaluation of exposures that are less than 10% of a lifetime. Therefore, it is appropriate to use a subchronic RfD to evaluate noncancer risks for the 1-6 year old child. USEPA Region 8 has derived an oral RfD for arsenic of 0.015 mg/kg-day that addresses both acute and subchronic exposures (USEPA, Region 8, 2001). This value is 50 times higher than the chronic RfD that EPA used for arsenic (0.0003 mg/kg-day). According to Region 8, the subchronic RfD is appropriate to quantify non-cancer health risks from subchronic exposures to inorganic arsenic lasting 15 days to 7 years (USEPA, Region 8, 2001). If the Region 8 subchronic arsenic RfD is used, the noncancer risks would be about 50 times lower than those presented in Table 1, since arsenic contributes more than 99% of the noncancer risks for these stations.

Table 1
EPA and Revised Risk Calculations

Current Cancer Risk
Exposure Factors Revised: Exposure Frequency, Soil Ingestion Rate

	EPA Current RME Risks		Revised Current RME Risks	
Station	**Exp Freq (d/yr)**	**Cancer Risk**	**Exp Freq (d/yr)**	**Cancer Risk**
WH	26	1E-04	4	8E-06
CB-03	104	**3E-04**	6	9E-06

Current Noncancer Risk
Exposure Factors Revised: Exposure Frequency, Soil Ingestion Rate

	EPA Current RME Risks		Revised Current RME Risks	
Station	**Exp Freq (d/yr)**	**Noncancer Risk**	**Exp Freq (d/yr)**	**Noncancer Risk**
WH	26	**2**	4	0.2
CB-03	104	**6**	6	0.2

Notes:
1. *Values in bold exceed 1E-04 for cancer risks or 1 for noncancer risks.*
2. *Revised soil ingestion rates taken from USEPA Exposure Factors Handbook (1997), Table 4-25: Child: 100 mg/day, Adult: 50 mg/day.*

(Continued)

Table 1
EPA and Revised Risk Calculations (cont'd)

Future Cancer Risk
Exposure Factors Revised: Exposure Frequency, Soil Ingestion Rate

Station	EPA Future RME Risks		Revised Future RME Risks	
	Exp Freq (d/yr)	Cancer Risk	Exp Freq (d/yr)	Cancer Risk
WH	78	**4E-04**	6	2E-05
NT-1	78	**5E-04**	6	2E-05
NT-2	78	**2E-04**	6	8E-06
NT-3	78	1E-04	6	4E-06
CB-03	104	**3E-04**	6	9E-06
13/TT-27	78	**8E-04**	6	3E-05

Future Noncancer Risk
Exposure Factors Revised: Exposure Frequency, Soil Ingestion Rate

Station	EPA Future RME Risks		Revised Future RME Risks	
	Exp Freq (d/yr)	Noncancer Risk	Exp Freq (d/yr)	Noncancer Risk
WH	78	**7**	6	0.3
NT-1	78	**8**	6	0.3
NT-2	78	**3**	6	0.1
NT-3	78	**2**	6	0.1
CB-03	104	**6**	6	0.2
13/TT-27	78	**10**	6	0.4

Notes:
1. *Values in bold exceed 1E-04 for cancer risks or 1 for noncancer risks.*
2. *Revised soil ingestion rates taken from USEPA Exposure Factors Handbook (1997), Table 4-25: Child: 100 mg/day, Adult: 50 mg/day.*

3.2 Probabilistic Risk Calculations

In order to assess the uncertainty associated with EPA's deterministic risk calculations, Gradient performed probabilistic risk calculations for the ingestion of arsenic in sediment at stations WH, NT-1, NT-2, NT-3, 13/TT-27, and CB-03. The probabilistic risk calculations are presented to help put EPA's risks into perspective, and because USEPA Region I "considers Monte Carlo analysis to be an acceptable approach for analyzing uncertainty in the risk assessment" (USEPA, 1994).

Probabilistic risk calculations use distributions for the input parameters instead of point estimates, to express the fact that a given exposure parameter may have a range of plausible values for different individuals. We used distribution inputs for five exposure parameters: exposure frequency, sediment ingestion rate, body weight, bioavailability, and fraction from site. For the purpose of this calculation, we used EPA's point estimates for the exposure point concentration (EPC), exposure duration, averaging time, and cancer slope factor. EPA guidance (USEPA, 2001b) states that the EPC should be a point estimate rather than an input distribution, and distributions are not available for the cancer slope factor.

The input distributions used for each exposure parameter are described in Table 2. We used a uniform distribution for bioavailability because we have a range for this parameter, but it is difficult, at this time, to identify any particular value as more likely than any other. Inputs for other distributions are based on literature values or professional judgment.

Table 3 presents the results of the probabilistic risk calculations. All of the 90th percentile cancer risks are at or below $2x10^{-5}$, and all of the 95th percentile cancer risks are at or below $3x10^{-5}$. The 95th percentile risk is $1x10^{-5}$ at both WH and CB-03, $2x10^{-5}$ at NT-1, $6x10^{-6}$ at NT-2, $4x10^{-6}$ at NT-3, and $3x10^{-5}$ at 13/TT-27. The 95th percentile risk is used here as an estimate of the RME, because EPA's Guidance for Probabilistic Risk Assessment states that "In human health PRA, a recommended starting point for risk management decisions regarding the RME is the 95th percentile of the risk distribution." (EPA, 2002; p. 7-4). The 95th percentile risk means that there is a 95% probability that the risk to any one individual will be below this value. The probabilistic noncancer hazard quotients are presented in Table 3. The 95th percentile noncancer hazards range from 0.07 to 0.95 and are all less than EPA's acceptable hazard of 1.0.

The probabilistic risks are substantially lower than EPA's individual risk estimates for the ingestion of arsenic in sediment (Table 1). Although the probabilistic risks are only for the ingestion of arsenic in sediment, this pathway represents a major portion (about 75%) of EPA's total cancer risks for these stations. This analysis indicates that EPA's RME risk, derived by using point estimates for all inputs, is a very high end value and hence is not representative of an RME value. Use of a more plausible range of exposure inputs results in risks falling within EPA's acceptable risk range of 10^{-6} to 10^{-4}. The probabilistic risks corroborate the revised deterministic risks (Table 1), in that both sets of risks do not exceed EPA's acceptable risk levels when more realistic inputs are used.

A sensitivity analysis was also performed as part of the probabilistic risk calculations. The results of the sensitivity analysis indicate that the calculated cancer risk is most sensitive to the Child exposure frequency, the Child fraction from site, and the Child sediment ingestion rate. These three parameters together account for 69% of the variability in the calculated cancer risk. This means that variation in the values used for these parameters has a large influence on the calculated risk. Thus, the sensitivity analysis highlights the fact that use of accurate and reasonable values for these parameters is critical to the overall confidence in the predicted risks.

Table 2
Distributions for Exposure Parameters

Parameter	Assumed Distribution	Distribution Parameters: WH (Current)	Distribution Parameters: CB-03 (Current and Future)	Distribution Parameters: WH, NT-1, NT-2, NT-3, 13/TT-27 (Future)	Source
Exposure frequency	Lognormal	Range = 1-20 50tho% = 4 95tho% = 12	Range = 1-20 50tho% = 6 95tho% = 12	Range = 1-20 50tho% = 6 95tho% = 12	Professional judgment based on site visits.
Sediment ingestion rate	Lognormal	Child: Range = 1-300 50tho% = 45 95tho% = 124	Child: Range = 1-300 50tho% = 45 95tho% = 124	Child: Range = 1-300 50tho% = 45 95tho% = 124	Literature values, see Appendix A.
		Adult: Range = 1-300 50tho% = 23 95tho% = 100	Adult: Range = 1-300 50tho% = 23 95tho% = 100	Adult: Range = 1-300 50tho% = 23 95tho% = 100	Used half the child value for 50th percentile, and EPA value for 95th percentile.
Body weight	Normal	Child: Range = 11-19 Mean = 15 Stdev = 2	Child: Range = 11-19 Mean = 15 Stdev = 2	Child: Range = 11-19 Mean = 15 Stdev = 2	EPA Exposure Factors Handbook
		Adult: Range = 34-216 Mean = 70 Std Dev = 4	Adult: Range = 34-216 Mean = 70 Std Dev = 4	Adult: Range = 34-216 Mean = 70 Std Dev = 4	
Bioavailability of Arsenic in Sediment	Uniform	Min = 37% Max = 51%	Min = 37% Max = 51%	Min = 37% Max = 51%	EPA swine study
Fraction from site	Triangular	Min = 0% Max = 100% Most likely = 50%	Min = 0% Max = 100% Most likely = 50%	Min = 0% Max = 100% Most likely = 50%	Professional judgment.

Table 3
Probabilistic Cancer Risks
Current Risks from Ingestion of Arsenic in Sediment

Station	Arsenic EPC (mg/kg)	Probabilistic Cancer Risk 90th Percentile	Probabilistic Cancer Risk 95th Percentile	EPA Point Estimate Current RME Risk from Ingestion of Arsenic in Sediment
WH	1900	8.0E-06	1.1E-05	8.6E-05
CB-03	1400	7.6E-06	1.0E-05	2.6E-04

Probabilistic Noncancer Hazards
Current Risks from Ingestion of Arsenic in Sediment

Station	Arsenic EPC (mg/kg)	Probabilistic Noncancer Hazard 90th Percentile	Probabilistic Noncancer Hazard 95th Percentile	EPA Point Estimate Current RME Hazard from Ingestion of Arsenic in Sediment
WH	1900	0.15	0.21	1.5
CB-03	1400	0.14	0.19	4.5

(Continued)

Table 3 (continued)
Probabilistic Cancer Risks
Future Risks from Ingestion of Arsenic in Sediment

Station	Arsenic EPC (mg/kg)	Probabilistic Cancer Risk 90th Percentile	95th Percentile	EPA Point Estimate Future RME Risk from Ingestion of Arsenic in Sediment
WH	1900	1.0E-05	1.3E-05	2.6E-04
NT-1	2500	1.4E-05	1.8E-05	3.3E-04
NT-2	820	4.5E-06	5.9E-06	1.1E-04
NT-3	500	2.7E-06	3.5E-06	6.7E-05
13/TT-27	4200	2.3E-05	2.9E-05	5.7E-04
CB-03	1400	7.6E-06	1.0E-05	2.6E-04

Probabilistic Noncancer Hazards
Future Risks from Ingestion of Arsenic in Sediment

Station	Arsenic EPC (mg/kg)	Probabilistic Noncancer Hazard 90th Percentile	95th Percentile	EPA Point Estimate Future RME Hazard from Ingestion of Arsenic in Sediment
WH	1900	0.19	0.25	4.6
NT-1	2500	0.24	0.32	6.0
NT-2	820	0.08	0.11	2.0
NT-3	500	0.05	0.07	1.2
13/TT-27	4200	0.41	0.95	10
CB-03	1400	0.14	0.19	4.5

Appendix A

Recent Studies of Soil Ingestion Rate

Appendix A Recent Studies of Soil Ingestion Rate

EPA's use of RME sediment ingestion rates of 200 mg/day for a child and 100 mg/day for an adult is overly conservative. These values are based on 1994 Region I Guidance. EPA's 1997 Exposure Factors Handbook recommends soil ingestion rates of 100 mg/day for a child and 50 mg/day for an adult (USEPA, 1997). These values were used in our deterministic risk calculations presented in Section 3.1. In addition, more recent studies indicate that the average and high-end soil ingestion rates are lower than the 1994 values used by EPA. Recent studies of soil ingestion rates are discussed below. The results of these studies indicate that child soil ingestion rates would be better described by a mean rate of 45 mg/day, and a 95th percentile rate of 124 mg/day. This distribution was used in our probabilistic risk calculations described in Section 3.2.

Stanek and Calabrese (1995a) performed a re-analysis of a previous soil ingestion study of 64 children (ages 1-4) in Amherst, Massachusetts (Calabrese *et al.*, 1989). The Amherst study is one of the most comprehensive and detailed studies of children's incidental soil ingestion to date (Calabrese *et al.*, 1989). In this study, incidental soil ingestion rates were estimated using a mass balance approach. In the re-analysis, the Amherst data were used to develop distributions of potential daily soil ingestion rates, including estimates for various percentiles of the study population. Using this approach, the authors estimated a mean soil ingestion rate for the 50th percentile child (ages 1-4 years) of 45 mg/day (Stanek and Calabrese, 1995a). This re-analysis differs from earlier interpretations of the Amherst study (including evaluations conducted by the study researchers) and reflects a more robust approach that takes into account a greater degree of the information reflected in the study data.

Stanek and Calabrese (1995b) re-analyzed a combined data set (n=168) based on the Amherst study mentioned above, and another soil ingestion study by Davis *et al.* (1990) that involved 104 children (ages 2-7) in the state of Washington. Based on their re-analysis of the combined dataset, the authors estimated a mean soil ingestion rate for the 50th percentile child of 37 mg/day.

Stanek and Calabrese (2000) performed a soil ingestion study of 64 children (ages 1-4 years) living on a Superfund site in Anaconda, Montana. Stanek and Calabrese derived a seven-day average soil ingestion rate for the 50th percentile child of 17 mg/day. (The comparable value based on the 1989 Amherst population was 45 mg/day.) The seven-day average soil ingestion rate for the 95th percentile child was 141 mg/day (compared to 208 mg/day for the Amherst population.) Stanek and Calabrese (2000) also estimate average soil ingestion rates over longer time periods, based on the seven-day study period. They estimate that the 95th percentile child will have a 365 day average soil ingestion rate of 106 mg/day for the Anaconda population and 124 mg/day for the Amherst population. These estimates are based on an analysis of uncertainty in the daily soil ingestion estimates, using standard statistical techniques.

Appendix B

Arsenic Toxicity

Appendix B Arsenic Toxicity

The current arsenic Cancer Slope Factor (CSF) for arsenic of 1.5 $(mg/kg\text{-}day)^{-1}$ is based on skin cancer observed in a study of over 40,000 people in Taiwan who were exposed for a significant portion of their lifetime to high concentrations of arsenic in groundwater used for drinking water (Chen *et al.*, 1985; Tseng *et al.*, 1968). The CSF derived from this study is generally believed to be conservative – see for example, Morales *et al.*, 2000; SEGH, 2002; Brown *et al.* 2000; and Buchet and Lison, 2000. This section discusses the toxicity of arsenic, providing evidence of the conservatism in the current USEPA CSF for arsenic. Although we do not necessarily suggest that EPA use an alternative value for the CSF, this Appendix provides a perspective on the conservatism in the calculated risks. Several studies conducted in the U.S. have shown that people exposed to arsenic in drinking water, at doses higher than those estimated in this risk assessment, do not have an increased risk of cancer. In addition, the estimated doses of arsenic for individuals exposed to this site are much lower than those in studies of overseas populations that do show evidence of an increased risk of cancer from exposure to arsenic.

B.1 U.S. Epidemiological Studies of Arsenic Carcinogenicity

B.1.1 Overview of U.S. Epidemiological Studies of Arsenic Exposure

Several well-designed epidemiological studies have been conducted in U.S. populations with highly elevated arsenic exposures. The U.S. epidemiological studies consistently show a lack of association between arsenic exposure and cancer outcomes. Table B-1 summarizes findings from the best available epidemiological studies of U.S. populations with elevated arsenic exposures, including two with high childhood exposures. These studies are summarized below:

- The Lewis *et al.* (1999) study, conducted by USEPA scientists, was designed to investigate the health effects of chronic consumption of arsenic-contaminated drinking water in a cohort of 4,058 residents of Millard County, Utah. For the seven communities included in the study, average drinking water concentrations ranged from 18 to 191 µg/L, and maximum detected concentrations ranging as high as 620 µg/L. Together with information on the residence history of the cohort members, the median drinking water concentrations were used to establish three arsenic exposure indices: low (<1,000 ppb-years), medium (1,000-4,999 ppb-years), and high (≥5,000 ppb-years).

- Despite highly elevated exposures to arsenic in drinking water, Lewis *et al.* (1999) reported the lack of a relationship between bladder and lung cancer and exposure to drinking water arsenic in the Utah cohort. A small, but statistically significant increase in prostate cancer was noted, but it was not dose dependent, and thus does not confirm a relationship between arsenic and prostate cancer.

- Based on their findings, the authors concluded "Whereas the studies in Taiwan and Argentina reported high exposures to drinking water arsenic, this study population was exposed to much lower levels, perhaps indicating that bladder cancer occurs in response to higher arsenic."

- A case-control study in Utah failed to find a relationship between bladder cancer and arsenic exposure from drinking water. The drinking water concentrations of arsenic in this study averaged 5μg/L (the total range was 0.5-160 μg/L). While this case-control study suggested that smoking might potentiate the effects of arsenic-induced bladder cancer, this observation was not consistent with respect to latency period (Bates *et al.*, 1995).

- A large ecological study, conducted by Morton *et al.* (1976), examined skin cancer incidence in a large study population of 190,871 exposed to arsenic drinking water concentrations averaging 16.5 μg/L and 4.8 μg/L in rural and urban regions respectively. No relationship between skin cancer and arsenic was found. Based on results, the authors stated that "it seems safe to conclude that our data showed no evidence of water arsenic influence on skin cancer incidence in Lane County over this 14-year period."

- In Churchill County, Nevada, Moore *et al.* (2002) investigated the relationship between childhood cancer incidence and arsenic exposure in drinking water from 1979 to 1989. Over 327,000 Nevada children were grouped into low, medium, and high exposure categories (*i.e.*, >10 μg/L, 10-25 μg/L and 35-90 μg/L, respectively). No statistically significant association between arsenic and any type of childhood cancer was found in any of the exposure groups.

- Tollestrup *et al.* (2002) used a cohort of over 3,000 children (aged 2 to 14) who had lived in close vicinity to the ASARCO Ruston copper smelter between the years 1910 and 1932 to examine to association between arsenic exposure and cause of death, which occurred 30 to 80 years after exposure. The authors used the number of years lived in a one-mile radius (*i.e.*, designed categories of 0- < 1.0 year, 1.0-3.9 years, 4.0 -9.9 years, and >10 years) of the smelter stack as a surrogate for arsenic exposure. The study found no evidence of increased bladder or lung cancer mortality rates, even in the three highest arsenic exposure categories.

- Lamm and coworkers (2002) conducted an extensive analysis of the relationship between arsenic in drinking water and cancer incidence using data from 133 US counties and over 75 million person-years of observations. Bladder cancer mortality data were collected for the years 1950 to 1979 along with Unites States Geological Survey (USGS)-derived data on arsenic levels in US groundwater supplies. Bladder cancer standard mortality ratios (SMRs) from individual counties dependent on groundwater as a drinking source, having median levels ranging from 3-60 μg/L, were compared to county-specific arsenic groundwater concentrations. Linear regression analysis of these data indicated that the slope estimate of this relationship was indistinguishable from zero, *i.e.* there was no evidence of a dose response relationship between arsenic intake and bladder cancer.

In summary, despite some highly elevated arsenic exposures (higher than those for the Aberjona River), these studies do not show evidence of increased excess bladder, lung, or skin cancer risk in the United States. These studies indicate that ingestion of arsenic in drinking water, at the levels found in the U.S., do not cause cancer. It should be noted that what are considered to be elevated arsenic exposures among U.S. populations are still substantially lower than those of the Taiwanese and South American populations where large excess lifetime bladder, lung, and skin cancer risks have been observed. Consequently, these U.S. epidemiological studies are suggestive of a possible threshold for arsenic carcinogenicity. Findings from these studies thus indicate that the use of a cancer slope factor (CSF) based on studies of cancer occurrence (bladder, lung, and skin) in highly exposed Taiwanese populations may result in overestimates of arsenic-related cancer risk in the United States.

B.1.2 Interpretation of U.S. Studies

Prevalence of Skin Cancer In Populations With Elevated Arsenic Exposures

As noted above, there is a lack of observed skin cancer cases in U.S. epidemiological studies of populations with elevated arsenic exposures. Valberg *et al.* (1998) examined whether this observation was more likely due to an absence of risk in U.S. populations or random variability from a predicted risk. This was done using a likelihood ratio approach that evaluated which of two hypotheses was the more likely explanation for the lack of observed skin cancer cases in the studies of U.S. populations. This analysis showed that no effect of arsenic on skin cancer prevalence was about 2.2 times more likely than an effect of arsenic exposure on skin cancer prevalence as predicted by EPA's current arsenic cancer potency factor of 1.5 $(mg/kg/day)^{-1}$. This study thus indicates that using a cancer potency factor based on a study of elevated arsenic exposures in the Taiwanese population may result in overestimates of skin cancer prevalence in the U.S. population.

Power of U.S. Epidemiological Studies To Detect Arsenic-Related Health Risks

A recent sample size calculation published in *Environmental Health Perspectives* supports the point that epidemiological studies of U.S. populations, such as the Lewis *et al.* (1999) study of Millard County, Utah, have sufficient power to detect the postulated arsenic-health risks if the risks are indeed as high as those estimated for Taiwanese populations (Frost *et al.*, 2002). Specifically, Frost *et al.* (2002) estimated the sample size required to test the arsenic risk predicted by Morales *et al.* (2000) for the United States.[5] In order to detect these large predicted excess risks, Frost *et al.* concluded that a sample size of approximately 1,400 would be needed for an arsenic drinking water exposure level of 100 µg/L. This sample size requirement was more than satisfied by the Lewis *et al.* (1999) study of a cohort of 4,058 individuals in Millard County, Utah, described in Section B.1.1. Frost *et al.* concluded that their findings were inconsistent with the "postulated excess risk for lung and bladder cancers", and did not "support the concerns that epidemiologic studies in the United States are not sufficiently powerful to detect the postulated arsenic-related health risks."

B.2 Non-U.S. Epidemiological Studies of Arsenic Carcinogenicity

Several studies conducted outside the United States have established arsenic as a skin, bladder, and lung carcinogen in humans. However, many of these studies have found an increased risk of cancer only at relatively high doses of arsenic, *i.e.,* arsenic concentrations in drinking water greater than 100 µg/L (for review see Brown and Ross, 2002). Several key studies are summarized below:

- The relative risk for urinary cancer and transitional cell carcinoma in a northeastern Taiwanese study population (based on a National Taiwan comparison group) was statistically significant only at arsenic concentrations in drinking water greater than 100 µg/L (Chiou *et al.*, 2001).

[5] The Morales *et al.* (2000) re-analysis of internal cancer risks in the arsenic-endemic region of southwestern Taiwan was used by U.S. EPA to calculate cancer risks at various MCL options in revising the arsenic drinking water regulations.

- Morales *et al.* (2000) re-analyzed the original data from Southwestern Taiwan. Using a the Taiwanese population as a comparison group, a recalculation of the relative risks for lung and bladder cancer showed a statistically significant dose-response relationship only at arsenic concentrations in drinking water that were greater than 400 μg/L.
- Lamm (2003) also re-analyzed data from southwestern Taiwan, considering differences in arsenic exposure from artesian (pressurized deep water) *vs.* non-artesian (shallow water) wells. Lamm concluded that bladder cancer incidence was independent of arsenic levels in villages that did not rely on the artesian wells as a water source. In contrast, when a village relied exclusively on water from artesian wells, a relationship was found. This indicates that contaminants in artesian wells (*i.e.*, humic acids, fluorescent substances, and fungal toxins), other than arsenic, may have contributed to increased bladder cancer risk.
- Guo and Tseng (2000) re-collected and re-analyzed data from Southwestern Taiwan. The study examined both bladder cancer incidence and death in the arsenic-contaminated region. While the study demonstrated a relationship between arsenic concentration and bladder cancer (incidence and death), this relationship was observed only at drinking water arsenic concentrations greater than 640 μg/L.
- In a cross-sectional study from Inner Mongolia (Tucker *et al.*, 2001; as cited in NRC, 2001), skin cancer was observed only in individuals exposed to peak concentrations of 150 μg/L or greater.

B.3 Non-linearity of Dose-response Relationship for Arsenic Carcinogenicity

The use of a cancer slope factor to quantify cancer risks associated with arsenic ingestion includes the default assumption that the dose-response relationship is linear at low doses. This assumption implies that even a very low dose of arsenic confers some excess cancer risk, and that, as the dose increases, risk increases in a directly proportional fashion. Careful examination of the biological principles that govern arsenic toxicity indicate that this assumption is incorrect for arsenic and that the true dose-response relationship is likely to be sub-linear or non-linear. Thus, from a toxicological perspective, low doses of arsenic would be relatively less harmful than higher doses, and may, in fact, be associated with zero risk.

A key fact that supports non-linearity for the arsenic dose-response relationship is associated with the way in which arsenic alters gene expression (Rudel *et al.*, 1996; Kitchin *et al.*, 2001). Specifically, arsenic does not interact directly with DNA to produce point mutations, but instead may modify gene transcription through one or more indirect mechanisms, including chromosome alterations, changes in DNA-methylation patterns, and perturbation of key regulatory enzymes.

A description of possible mechanisms of arsenic-induced carcinogenesis is provided below. These mechanisms are not mutually exclusive and all are consistent with a non-linear dose-response relationship.

- Arsenic has conclusively been shown to induce chromosome damage without interacting with DNA in cell culture systems as well as in animals. (Noda *et al.*, 2002; Wang *et al.* 1994; Vega *et al.*, 1995; NRC 1999).

- Arsenic affects DNA methylation status, which can affect the transcriptional regulation of genes critical to cell growth and cell death (Zhao *et al.*, 1997; Mass and Wang, 1997).
- Arsenic may inhibit aspects of DNA repair including inhibition of p53 (Mass and Wang, 1997) and components of the nucleotide excision repair system (Hu *et al.*, 1998; Andrew *et al.*, 2003)
- Arsenic may modulate cell signaling pathways responsible the regulation of cell proliferation. Specifically, exposure to arsenic can activate the c-Src dependent Epidermal Growth Factor Receptor (EFGR) and the mitogen-activated protein kinase (MAPK) cell signaling pathways (Simeonova and Luster, 2002; Bode and Dong, 2001)
- Metabolism of arsenic to its trivalent methylated metabolites (MMA^{III} and DMA^{III}) can generate reactive free oxygen radicals that can cause DNA damage (Kitchin *et al.*, 2003; Mass *et al.*, 2001).
- Treatment of human cells with micromolar concentrations of arsenic can induce protective cellular mechanisms such as the enhanced transcription of glutathione-related genes and induction of heat shock proteins (Del Razo *et al.*, 2001; Schuliga *et al.*, 2002).
- Luster (2003) suggests that arsenic acts through multiple mechanisms and suggests that the dose-response for arsenic is likely to be non-linear in the low dose region.

Based on available data, including the above proposed modes of action, arsenic does not appear to be an initiating carcinogen (*i.e.*, the type of carcinogen for which a linear dose-response relationship is plausible).

Despite the strong evidence that arsenic does not exert its toxicity in a linear fashion, both the EPA and the NRC have used linear models to estimate human risks at low arsenic exposures. This decision was made based on a 1996 EPA guidance document which states that, in the absence of definitive mode of action, a linear default assumption will be utilized. Thus, the decision to reject a non-linear or threshold model for arsenic carcinogenesis was a decision based on policy and not the most biologically plausible model. Because the EPA cancer slope factor in IRIS is based on a linear dose-response relationship, and the true dose-response is likely to be non-linear, use of the cancer slope factor is likely to overestimate cancer risks at exposure levels lower than those experienced in the Taiwanese study upon which the CSF is based.

Evidence of arsenic's non-linearity is further supported by evidence from epidemiological studies. As discussed previously, U.S.-based studies indicate that elevated of levels of arsenic in drinking water are not associated with increased bladder and lung cancer risk. In addition, studies from Taiwan and Inner Mongolia demonstrate that arsenic does not pose a significant cancer risk until drinking water levels are greater than 100 µg/L. Collectively, these studies indicate that increased risk of cancer is not associated with low doses of arsenic.

B.4 Evaluation of Exposure to Arsenic in Soil

By comparison with food and water, incidental ingestion of arsenic from contaminated soil or sediment does not contribute significantly to total arsenic intake and resulting arsenic body burden. The modest impact of arsenic on body burden is evidenced by studies that show low increases in urinary arsenic levels after soil exposure. Although elevated urinary arsenic levels were reported to be associated with very high soil arsenic levels near copper smelters (Baker *et al.*, 1977; Binder *et al.*, 1987), studies of populations of children residing in communities with concentrations of arsenic in soil at or below 200 mg/kg indicate very little, if any, effect of arsenic in soil on body burden of arsenic, as reflected in urine arsenic levels (Valberg *et al.*, 1997; Hewitt *et al.*, 1995). In addition, the Anaconda, MT study demonstrated that urinary arsenic levels were unaffected by soil arsenic levels as high as 500 mg/kg (Hwang *et al.*, 1997). This observation is likely due to the small impact of soil arsenic relative to the impact of background levels of arsenic in food and water. Although there is no literature specifically on arsenic exposures to sediment, we would expect that exposure to sediment would be similar to that in soil, and that it would have a similarly small impact.

Studies of arsenic contamination in the area adjacent to the former ASARCO copper smelter in Ruston, Washington indicate that childhood exposures to arsenic in soil and air do not result in increased rates of bladder or lung cancer during adulthood. The study followed a cohort of children residing in the area during smelter operation during 1907-1932. The authors used the number of years lived within a one-mile radius of the smelter stack as a surrogate for total ambient arsenic exposure *via* soil and air. Exposure was evaluated as a function of duration of residence (categories of 0-<1.0 year, 1.0-3.9 years, 4.0-9.9 years, and >10 years). Arsenic soil concentrations ranged from 100 to 1600 mg/kg when measured in 1974 (Harter *et al.* 1993), and thus were at least that high during the exposure period of 1907-1932. The study found no evidence of increased bladder or lung cancer mortality rates, even in the three highest arsenic exposure categories (Tollestrup *et al.*, 2002; Harter *et al.*, 1993; Frost, 2003). While the cohort in this study was exposed to arsenic *via* both soil and air, another study conducted at this site in the mid 1980's demonstrated that exposure to arsenic *via* incidental ingestion of soil had a strong correlation to urinary arsenic levels indicating that soil exposure is an important determinant of total arsenic dose in children (Polissar *et al.*, 1990).

Adverse health effects from exposure to arsenic in soil are not addressed in any of the above studies. ATSDR's Toxicity Profile for Arsenic (ATSDR, 2000) does recognize arsenic-contaminated soil as a potential source of adverse health effects. However, ATSDR acknowledges that arsenic-bound soil has low bioavailability, through both the oral and dermal route, that will limit toxicity. Additionally, the profile does not present any studies in which exposure to arsenic-contaminated soil resulted in adverse health effects.

B.5 Conclusions

Several U.S.-based studies provide evidence that even relatively high levels of arsenic in drinking water do not result in increased cancer risk. By estimating water consumption in these exposed populations, we can calculate total arsenic intake and compare these values to estimated exposures to arsenic in sediment along in the Aberjona River. It is also useful to compare site-specific exposures of arsenic to levels ingested at the MCL for arsenic in drinking water. In all cases, we find that exposures to arsenic in sediment along the Aberjona River are well below levels at which no cancer increase was observed in U.S. studies, and are also less than permissible exposures to arsenic in drinking water at the MCL of 10 μg/L.

EPA has estimated site-related lifetime daily average arsenic intakes up to 0.3 μg/kg-day for a child, and 0.13 μg/kg-day for an adult, (for future RME exposures at NT-1). In contrast, estimated arsenic intakes as high as 5.7 μg/kg-day have been experienced by U.S. populations without evidence of increased cancer risks (see Table B-1). Specifically, for the Lewis *et al.* (1999) study, which is among the largest and best-conducted of the epidemiological studies of U.S. populations with elevated arsenic exposures, average intakes of arsenic in drinking water ranged from 0.26 to 2.7 μg/kg-day (based on average drinking water consumption of 1L/day (Jacobs *et al.* 2000)). Over 1,200 members of the Millard County, Utah, cohort resided in the two communities with the highest intake level (average 2.5 μg/kg-day), many for their entire lifetimes. Despite these elevated intakes, no elevated death rates from bladder or lung cancers were observed for those who died through November 1996 (2,203 cohort members), and death rates were not elevated among the cohort members with the highest levels of drinking water arsenic. The observed bladder and cancer mortality risks in the Lewis *et al.* study are lower than the baseline health risks predicted for the general population of Utah, even with arsenic drinking water concentrations that on average were as high as 191 μg/L, and at times exceeded 600 μg/L.

In the non-U.S. studies cited in Section B.2, populations had exposure to arsenic in drinking water at concentrations of 100 μg/L or greater. In order to calculate arsenic intakes, certain assumptions must be made about the exposed populations. For example, using estimates of water consumption patterns in Taiwanese males developed by the National Research Council (NRC, 1999; NRC, 2001), calculated arsenic intakes at 100 μg/L are 5.5 μg/kg-day. This assumes an average Taiwanese male weighs 55 kg and drinks 3L/day of contaminated water. Moreover, if one assumes, based on the work of Lamm and Kruse (2003) and the re-analysis of the Taiwan data by Morales *et al.* (2000), that cancer is not increased until levels of 400 μg/L, then the estimated carcinogenic intake in Taiwan would be 22 μg/kg-day. In contrast, site-related exposures are considerably less than the drinking water exposures in these studies. For example, EPA's estimated arsenic intakes for an adult at CB-03 are 0.12 μg/kg-day, which is 45 times lower than doses received at 100 μg/L in the Taiwanese studies. Thus, modest intakes of arsenic from exposure to sediment along the river are unlikely to present a significant toxicological concern.

Estimated arsenic exposures along the Aberjona River are less than arsenic exposures permitted in drinking water at the MCL of 10 μg/L, which is a level designed to be health protective (USEPA, 2001a). As an example, EPA's RME estimates of arsenic intake at CB-03 are 0.27 μg/kg-day for children and 0.12 μg/kg-day for adults. By comparison, exposure to arsenic in drinking water at the current MCL of 10 μg/L would yield an estimated intake of 0.7 μg/kg-day for a 15 kg child and 0.3 μg/kg-day for a 70 kg adult, based on drinking water intakes of 1L/day for children and 2L for adults. Thus, site-related arsenic exposures are less than those considered by EPA to be health protective in drinking water.

Table B-1
Summary of Epidemiological Studies of Cancer Risks in U.S. Populations with Elevated Arsenic Exposures

Study Type	Study Location	Study Population(s)	As Drinking Water Levels (μg/L)	Average Daily As Intakes (μg/kg-day)	Key Findings on Cancer Health Effects	Reference
Lifetime/Adult Exposures						
Retrospective Cohort	Millard County, UT	4,058 Adults	Averages ranging from 18 to 191	0.26 to 2.7 (based on average water levels, 1 L/day ingestion rate, and 70 kg body weight)	No elevated death rates from bladder or lung cancers have been observed for those who died through November 1996, and death rates show no association with exposure level. For bladder and lung cancers together, the authors observed 39 deaths when 63.5 were expected ($p<0.05$).	Lewis *et al.*, 1999
Retrospective Cohort	Nationwide (133 US counties)	75 million person-years of observations	Median concentrations ranging from 3 to 60 μg/L	SMR: 0.73 (0.41 to 1.27) for bladder cancer at highest exposure level	After reviewing groundwater arsenic levels in 133 counties in the US dependent on groundwater as a drinking source, the authors found no relationship between arsenic exposure and bladder cancer mortality.	Lamm *et al.* 2002
Meta-analysis	Utilized studies of Fallon, NV (Vig *et al.*, 1984), Fairbanks, AK (Harrington *et al.*, 1978), and Millard County, UT (Southwick *et al.*, 1983)	105 for Fallon, 79 for Fairbanks, and 145 for Millard County	100 for Fallon, 76-401 for Fairbanks, and 208 for Millard County	1.4 for Fallon, 1.1-5.7 for Fairbanks, and 2.9 for Millard County (based on average water levels, 1 L/day ingestion rate, and 70 kg body weight)	No skin cancers were found in the exposed populations in each study location. This study further examined whether an absence of risk in U.S. populations or random variability from a predicted risk was the more likely explanation for the study findings. Likelihood ratio analysis showed that no effect of arsenic on skin cancer prevalence is about 2.2 times more likely than an effect of arsenic exposure on skin cancer prevalence as predicted by EPA's current arsenic cancer potency factor of 1.5 $(mg/kg/day)^{-1}$.	Valberg *et al.*, 1998
Case-control	88 towns in Utah	117 cases, 266 population-based controls	Range of 0.5 to 160, with a mean of 5 (81 out of 88 towns <10 μg/L; 1 town >50 μg/L)	0.001 to 2.3 (based on range of water levels, 1 L/day ingestion rate, and 70 kg body weight)	No association found between bladder cancer risk and arsenic exposure for two exposure metrics-total cumulative exposure (<19 up to >53 mg) and intake concentration. Analyses indicated increased bladder cancer risks for smokers, although authors could not rule out possible bias in data.	Bates *et al.*, 1995

Study Type	Study Location	Study Population(s)	As Drinking Water Levels (µg/L)	Average Daily As Intakes (µg/kg-day)	Key Findings on Cancer Health Effects	Reference
Ecological	Lane County, Oregon	190,871 total study population	Averages of 16.5 and 4.8 in all rural and urban regions, respectively, with a maximum recorded conc. of 33	Averages of 0.23 and 0.07 for rural and urban regions, respectively (based on average water levels, 1L/day ingestion rate, and 70 kg body weight)	Did not detect any excess risk of skin cancer associated with arsenic exposures up to 33 µg/L (note 19,063 people were exposed at this maximum concentration). Among the 3,237 skin-cancer cases identified in the study, only three had evidence of arsenic keratosis. "	Morton *et al.*, 1976
Childhood Exposures						
Ecologic Study	Entire State of Nevada, including Churchill County and Fallon, Nevada.,	327,947 children between 0-19 years of age	0-7.8 in low-exposure group, 10-24.6 in medium-exposure group, 35.9-91.5 in high-exposure group	0.57 to 1.4 in high-exposure group (based on average 0.6 L/day ingestion rate, and 38 kg body weight)	No statistically significant association between arsenic and any type of childhood cancer was found in any of the exposure groups.	Moore *et al.*, 2002
Retrospective Cohort	Ruston, Washington in vicinity of American Smelting and Refining Company (ASARCO) copper smelter	3,132 children residing near smelter between 1907-1932	Not reported in study (note that ambient air exposures are considered to be the primary exposure source)	Not known during 1907-1932 exposure period, although elevated urine As levels observed in 1970s following improvements in smelter processes	Despite elevated childhood As exposures, no elevated incidence of bladder or lung cancer mortality observed in 1,075 deceased members of cohort as of 12/31/90.	Tollestrup *et al.*, 2002

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Appendix C
Evaluation of the EPA's UCL Recommendations for Skewed Data Sets

Evaluation of the EPA's UCL Recommendations for Skewed Data Sets

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Exposure point concentrations (EPCs) used in risk assessments should reflect the average contaminant concentrations encountered by a receptor at a site. This parameter is typically represented by the upper 95% confidence limit on the mean (95% UCL). The 95% UCL of the concentration mean is a measure of the precision to which the average concentration can be measured. Statistically, the 95% UCL estimates the 95th percentile of the sampling distribution of the sample average. That is, if one were to create 100 sets of measurements each set selected at random from the same population having a known mean, then 95 of the computed UCL values would be expected to be above the true mean and 5 would be expected to be below the true mean. Any method for calculating the 95% UCL should have this property; while at the same time, it is preferable to use methods that do not substantially overestimate the true mean.

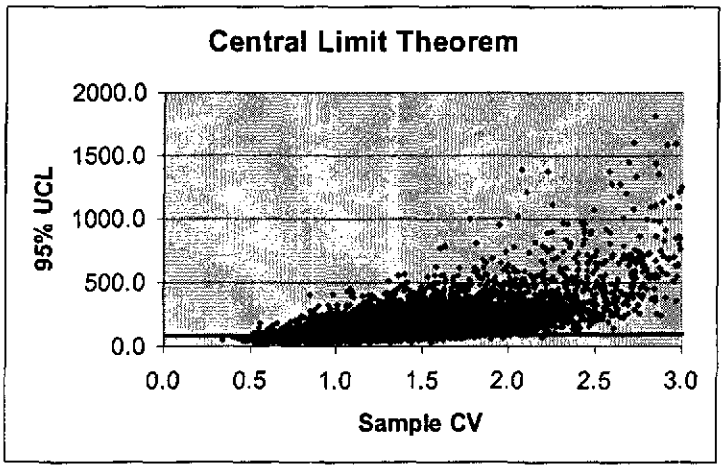
Numerous statistical methods are available for the calculation of 95% UCLs, however, they often yield disparate results. The U.S. Environmental Protection Agency (EPA) has recently provided guidance and companion software (EPA, 2002) for the calculation of EPCs at contaminated sites. These efforts extend previous EPA guidance (1992) by incorporating a variety of statistical methods and are generally considered an improvement of the earlier guidance. However, based on the results of an analysis we presented at the 2003 annual meeting of the Society of Toxicology (Mills et al., 2003), the EPA UCL recommendations may either underestimate or overestimate the true mean depending on site-specific data characteristics.

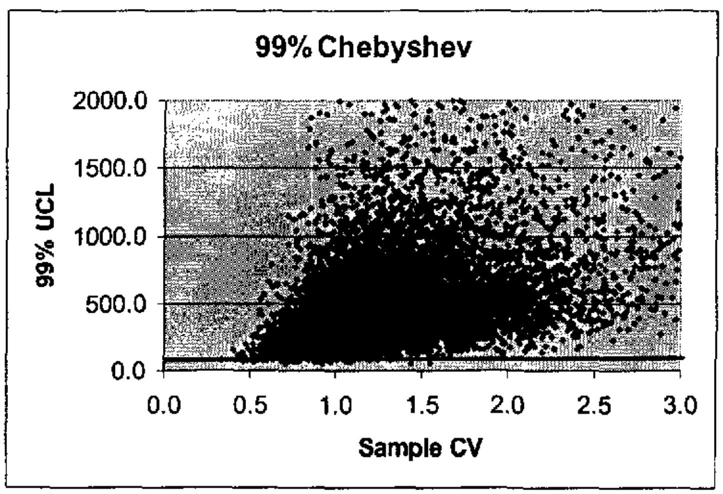
Our original analysis has significant implications for the UCLs selected by EPA to represent the EPCs in the human health risk assessment for the Wells G&H Superfund Site Operable Unit 3 - Aberjona River Study. An additional analysis was conducted to specifically evaluate the UCL selected by EPA to represent the EPC for the WH arsenic data set, a small, relatively skewed sample population with a sample size (n) of 12 and a Coefficient of Variation (CV) of 2.4. To evaluate the EPA methodology with this data set, we expanded our analysis on the performance of UCL methods to increase the sample observations in the 2.2 to 2.6 CV range, similar to the WH arsenic data set.

Although the true population parameters are never known for chemical concentrations at a site, a reasonable inference is that sample data with CV 2.4 were drawn from a population with CV 2.4. To evaluate this type of case, 10,000 synthetic lognormal data sets (n=12) were generated using Crystal Ball (Mean 100; Std 240; CV 2.4). For each sample data set, UCLs were calculated with the 95% CLT, 95% Bootstrap, 95% Chebyshev (MVUE), and the 99% Chebyshev (MVUE) methods. Table 1 below provides a summary of the UCL results for all the sample data sets. The Min and Max are the lowest and highest 95% UCL observed out of the data sets. Mean and Median UCLs are also shown. The 'Coverage' refers to the percent of the UCLs from the sample data sets that were larger than the true population mean of 100. For example, for 68% of the samples, the Central Limit Theorem (CLT) produced 95% UCLs greater than 100. By definition, a 95% UCL method providing nominal coverage would have a coverage of 95%.

Table 1. UCL results from 10,000 samples drawn from Ln(100, 240)					
	Min	Max	Median	Mean	Coverage
95% CLT	22.5	2383.1	131.9	169.7	68%
95% Bootstrap	21.6	2379.5	129.4	166.9	67%
95% H-Stat	29.9	93672.5	413.2	951.5	95%
95% Cheby (MVUE)	29.7	2871.8	236.3	294.2	93%
99% Cheby (MVUE)	51.1	5676.4	430.7	544.8	99%

These results suggest that the 95% H-statistic or the 99% Chebyshev (MVUE) would be the UCL method of choice since these two methods are the only ones to deliver at least the desired 95% coverage. We believe that EPA used a similar approach in the development of their UCL recommendations in ProUCL. If this is the case, EPA has neglected an important detail. The range of UCL results produced by each method is highly dependent on the sample CV. To illustrate this point, scatter plots of the UCL results (y-axis) versus the sample CV (x-axis) for the 95% CLT and 99% Chebyshev methods are shown in the two graphs below.





As the CVs of the sample data sets increase, the 99% Chebyshev (MVUE) method significantly over predicts the true mean with increasing frequency. The same is true of the CLT, but the extent of the "overage" is much more limited.

Given this observed relationship, we evaluated the coverage of the methods for the data sets with CVs in the range of 2.2 to 2.6, bracketing the WH arsenic data set (CV=2.4). Within the 10,000 sample data sets, 491 were identified with CVs in the range of 2.2 to 2.6. The performance of the CLT and Chebyshev (MVUE) UCL methods for this portion of the sample data is shown in Table 2 below.

Table 2. UCL results for 491 of 10000 samples drawn from Ln(100, 240) with sample CV of 2.2 to 2.6

	Min	Max	Median	Mean	Coverage
95% CLT	71.4	1374.8	329.3	375.9	99.4%
95% Cheby (MVUE)	72.3	2657.7	367.6	451.3	99.2%
99% Cheby (MVUE)	131.7	5176.4	683.6	856.8	100%

In this case, the coverage properties of these three methods are all adequate, in that all three provide at least 95% coverage. However, the 95% CLT produces the lowest mean and median UCLs indicating that the frequency of overestimation of the true mean (i.e., overage) is reduced. If the sample CV is a reasonable estimate of the population CV, this analysis indicates that the 95% CLT estimate provides 99% coverage and is a more appropriate (yet still conservative) estimate of the 95% UCL. When applied to the arsenic data set from the WH station, the 95% CLT yields a substantially lower UCL estimate (806 mg/kg) than the estimate based on the 99% Chebyshev (MVUE) method applied by EPA (1910 mg/kg).

An important uncertainty associated with this analysis is that the true population distribution that gives rise to site sampling data is never known. If the population is considerably more highly skewed than the sample would indicate, the coverage properties of these methods might be less than optimal. In fact, as the CV of the underlying population rises, eventually even the 99% Chebyshev method will fail to provide nominal coverage. Thus, if the population is considerably more skewed than the sample would indicate, then there is a higher probability that the UCL will under predict the true population mean. Alternatively, if the sample population was biased so as to produce sample data with more variability than the underlying population, then the UCL often greatly exceeds the true population mean.

The methodology used by EPA to develop recommendations for their ProUCL program is not available for review. It is unclear how the EPA distinguished between sample and population parameters in the development of the ProUCL recommendations. Use of sample parameters to estimate population parameters and underlying distribution types are particularly problematic when dealing with small sample sizes and highly skewed data sets. There is usually only weak evidence that the underlying population even follows a specified distribution. Formal Goodness-of-

Fit tests only provide for the exclusion of a specified distribution. In addition, point source contamination areas that fit highly skewed lognormal distributions would have very significant hot spots. For example, at sites with a population CV of greater than 5, we would expect to see more than four orders of magnitude difference between the lowest and highest sample concentrations, with the data set being heavily weighted at the low end. Distributions of this sort are certainly possible, but are probably the result of a mixture of populations resulting from different sources or activities rather than a true multiplicative (dilution) process as would be the assumption for a lognormal distribution. The use of lognormal theory to develop statistical confidence intervals for such nonparametric samples is highly suspect. In such cases, the only practical method of evaluating UCL performance is through simulation. This is the approach we used in the analysis presented at the 2003 annual meeting of the Society of Toxicology (cited above). We believe that recommendations developed using this type of approach are superior to those provided by EPA's ProUCL program.

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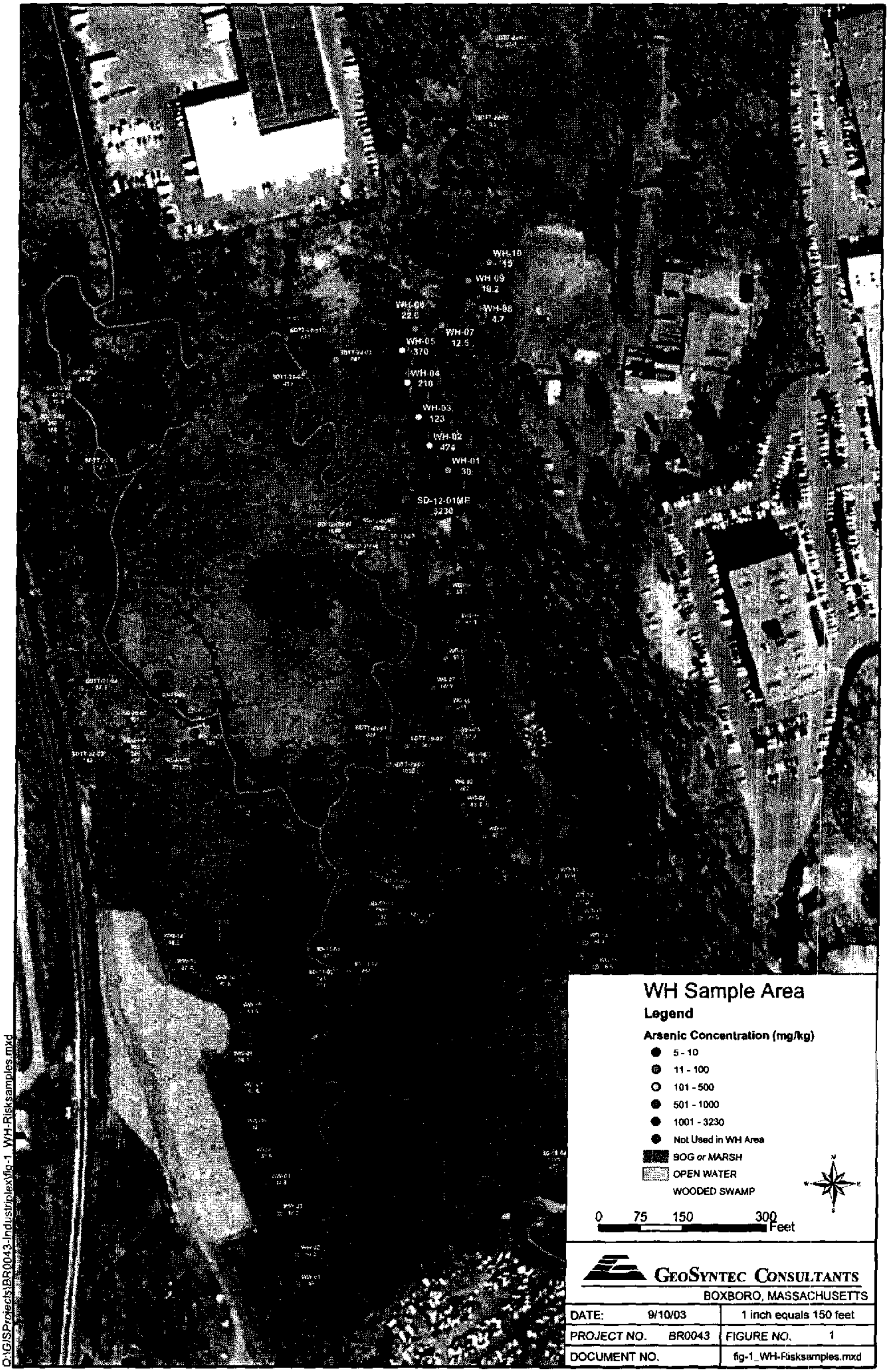

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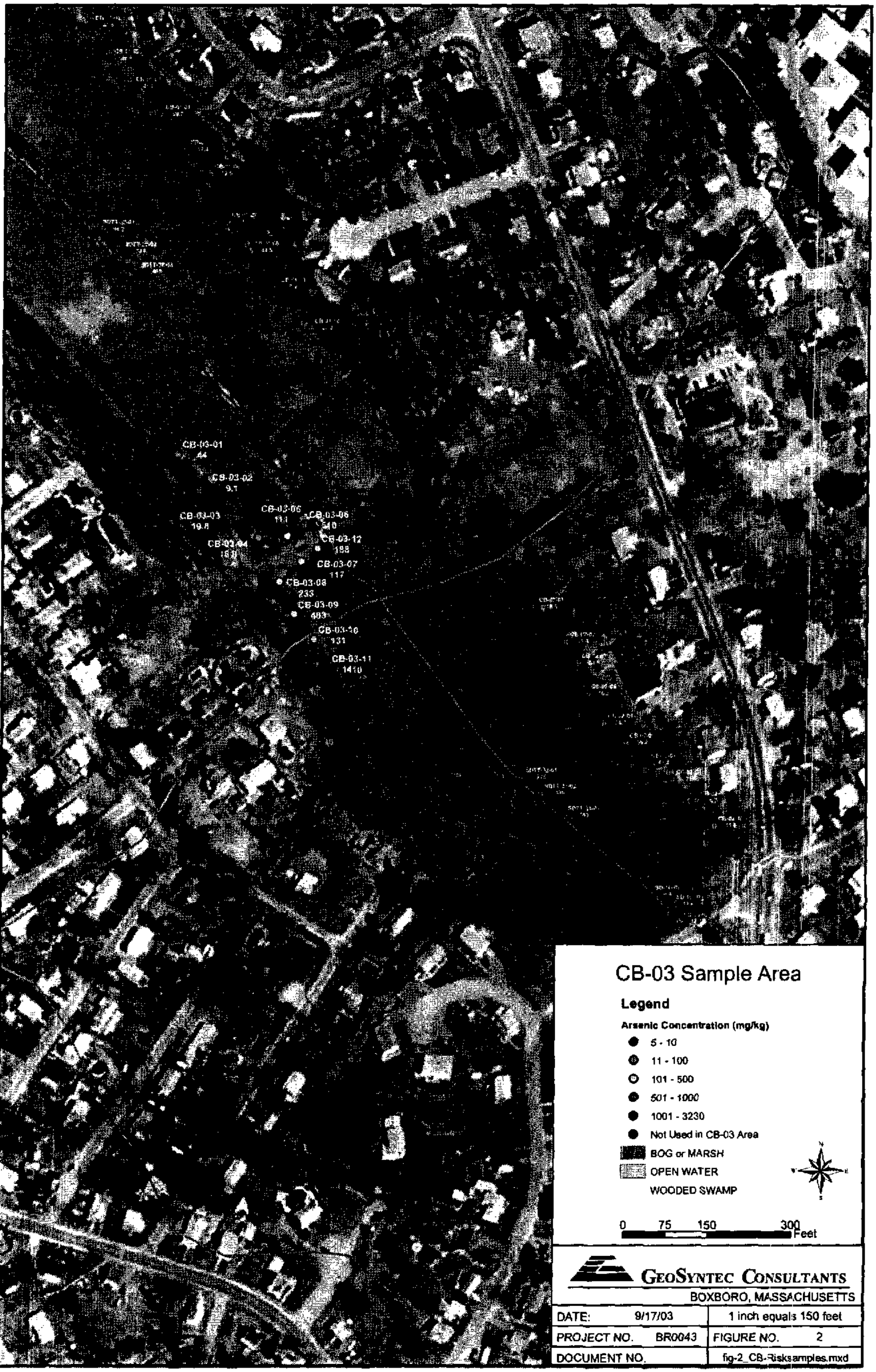

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Areas of Expertise

Risk assessment, exposure assessment, toxicology, metals, inhaled pollutants, soil contaminants, technical support for litigation.

Education & Certifications

Ph.D., Molecular Biology and Microbiology, Tufts University, 1976.

A.B., Biology, Bryn Mawr College, 1968.

Diplomate American Board of Toxicology, 1988; recertified 1994, 1999, 2003.

Fellow, Academy of Toxicological Sciences, 2002.

Member, UK Register of Toxicologists, 2004.

Professional Experience

1987 – Present GRADIENT CORPORATION, Cambridge, MA
Principal. Environmental consulting practice includes evaluation of chemical toxicity, health risk assessment for cancer and non-cancer endpoints, review of animal toxicology studies, and multi-media assessment of exposure to environmental chemicals. Special emphasis on metals and inhaled chemicals.

1985 – Present HARVARD SCHOOL OF PUBLIC HEALTH, Boston, MA
Visiting Lecturer in Toxicology.

1985 – 1987 REGION I ENVIRONMENTAL PROTECTION AGENCY, Boston, MA
Regional Expert in Toxicology and Supervisory Scientist, Air Toxics Staff. Performed risk assessments for toxic air pollutants. General staff responsibilities included air impacts at waste sites, state air toxic programs, and EPA radiation programs.

1979 – 1985 HARVARD SCHOOL OF PUBLIC HEALTH, Cambridge, MA
Research Associate in Environmental Science and Physiology and Fellow in Interdisciplinary Programs in Health. Developed short-term animal bioassay for pulmonary toxicants. Editor and author of monograph on variations in susceptibility to inhaled pollutants for both cancer and non-cancer endpoints.

1978 – 1979 TUFTS UNIVERSITY SCHOOL OF MEDICINE, Boston, MA
Instructor in Protein Chemistry. Isolated phagocytosis inhibiting factor from immunoglobulin of individuals with inherited susceptibility to bacterial infections.

1977 – 1978 HARVARD UNIVERSITY, Cambridge, MA
Postdoctoral Fellow in Biology. Researched novel properties of bacterial protein elongation factor, EF-Tu, relevant to possible role as a structural protein.

1975 – 1976 UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL, Worcester, MA
Postdoctoral Fellow in Microbiology. Isolated and analyzed messenger RNA from slime molds. Initiated project on elongation factor, EF-Tu.

1968 – 1969 TUFTS UNIVERSITY SCHOOL OF MEDICINE, Boston, MA
Research Assistant in Molecular Biology and Microbiology. Performed genetic and biochemical studies on bacterial lipopolysaccharide.

Professional Activities

- Member of Board of Directors, Academy of Toxicological Sciences, 2005 - present.
- Member of Scientific Advisory Committee to the Manganese Health Research Program, 2004-2005.
- CIIT Science Advisory Committee, 2002 – present.
- Program Committee, Society of Toxicology, 2001 – present.
- American Chemistry Council Risk Assessment Methods Technical Implementation Panel, 1998 - 2001.
- International Life Sciences Institute Steering Committee on Cumulative Risk Assessment, 1998.
- American Water Works Association Research Foundation Peer Review Panel on Arsenic, 1997 - 1998.
- Membership Committee, Society of Toxicology, 1997 - 2000.
- Continuing Education Committee, Society of Toxicology, 1996 - 1997.
- Risk Assessment Task Force, Society of Toxicology, 1996 to 2000; chair 1999 - 2000.
- Advisory Committee to Public Health Program, Florida A & M University, 1996 - 2002.
- Chair of Session on Ecological and Human Health Protocols at GRI meeting on Environmentally Acceptable Endpoints in Soil, Arlington, VA, 1995.
- Session Chair, International Conference on Arsenic, San Diego, CA, 1995.
- Watertown, MA, Board of Health, 1995 - present. Chair, 2003.
- Rapporteur 1994. USEPA Meeting on Risk Assessment for Chemical Mixtures, Research Triangle Park, NC.
- Program Committee, Society of Toxicology, 1993 - 1996.
- Member of Arsenic Task Force, Society for Environmental Geochemistry and Health, 1993 - present.
- Work Group on Arsenic, Society for Environmental Geochemistry and Health, 1993.
- President, Society of Toxicology, Risk Assessment Specialty Section, 1994 - 1995.
- Vice President, Society of Toxicology, Risk Assessment Specialty Section, 1993 - 1994.
- President, Northeast Chapter of the Society of Toxicology, 1992 - 1993.
- Review committee, EPA Workshop on the Methodology for Deriving National Ambient Water Quality Criteria for the Protection of Human Health, 1992.
- Consultant to SAB Committee on Hazardous Air Pollutants, 1991.
- Member of Advisory Committee to EPA on Metal Bioavailability, 1990.
- Member of Advisory Committee to Harvard Center for Risk Analysis, 1990 - 1993.
- Member of Committee on Public Communications, Society of Toxicology, 1990 - 1992.
- Councilor of Inhalation Specialty Section, Society of Toxicology, 1990 - 1992.
- Member of Technical Committee of Council for Health and Environmental Safety of Soils (CHESS), 1988 - Present.
- President, Northeast Chapter of the Society for Risk Analysis, 1987 - 1988.
- EPA Risk Assessment Forum, 1986 - 1987.
- Maine Science Advisory Panel, 1986 - 1990.
- Air Toxics Committee of Northeast States for Coordinated Air Use Management, 1985 - 1987.
- Rhode Island Air Toxics Advisory Committee, 1986 - 1987.
- Massachusetts Visibility/Public Health Index Peer Review Team, 1986.
- Massachusetts Air Toxics Guidelines Review Committee, 1985 - 1988.

- Peer Review Committee, EPA Inhalation RfD Document, 1987.

Professional Affiliations

American Thoracic Society • Society of Toxicology • Northeast Chapter of the Society of Toxicology • Society for Risk Analysis • New England Chapter of the Society for Risk Analysis • American Association for the Advancement of Science • Society of Environmental Geochemistry and Health • International Society for Exposure Assessment • Academy of Toxicological Sciences

Projects

Perchlorate Study Group: Comments on scientific validity of EPA RfD for perchlorate.

Parsons, Behle, & Latimer: Litigation support for lead and arsenic-contaminated site in western U.S., including critique of risk assessments and assistance in design and interpretation of epidemiological study.

Manufacturer of Perchloroethylene: Analysis of toxicity of PCE and review of state risk assessments at dry cleaning sites.

Wildman Harrold: Evaluation of risks associated with CCA-treated wood. Development of studies for CCA-treated wood.

Meadows Owens: Evaluation of health effects of ozone, including consideration of epidemiological, chamber and animal studies.

PG&E National Energy Group: Evaluation of exposures and risks of coal fly ash.

Ransom Environmental: Human health and ecological risk assessment for PAHs, dioxins, and other compounds at a former chemical R&D facility, including development and oversight of sampling.

EPRI: Synthesis report of arsenic research studies.

EPA, Office of Research and Development: Development of toxicity data base for inhalation exposure to the Hazardous Air Pollutants listed under the 1990 Clean Air Act Amendments.

Preti Flaherty: Risk communication and evaluation of toxicological causation for range of organic and inorganic compounds at landfill site.

Wood Preservative Science Council: Evaluation of EPA Stochastic Human Exposure Dose Simulation model.

Electronics Manufacturer: Risk communication to plant employees regarding exposures to TCE and DCE in groundwater.

Arthur D. Little: Evaluation of health significance of metal exposures, especially iron, at historic mine site in New England.

New Mexico Environment Department: Risk assessment for metals at copper mining and smelting site.

Howrey and Simon: Review of historic toxicological knowledge of PCBs for a case involving two manufacturing sites.

Lemle and Kelleher: Exposure and risk assessment for vinyl chloride, ethylene dichloride, other solvents, and mercury at on-going chemical manufacturer.

Chemical Manufacturers Association: Review of EPA land disposal regulations Phase IV. Review of ozone risk assessment in EPA ozone staff paper.

Multinational Manufacturer: Risk assessment and risk communication for perchloroethylene in drinking water at operating facility in Asia.

Spriggs Hollingsworth: Evaluation of risks and regulatory decisions associated with trichloroethylene in drinking water at site in southeastern U.S..

American Petroleum Institute: Role of risk assessment and potential cost savings in Superfund remedy selection process.

Mayer, Brown & Platt: Evaluation of elemental mercury exposure in residences.

Pesticide Manufacturer: Evaluation of toxicity and environmental migration of organo-arsenicals.

Salt River Project: Risk assessment and risk communication support for TRI emissions from coal-fired power plants.

Stauffer Management: Evaluation of possible air exposures and health studies at former phosphorous manufacturer in Florida.

Crosby Heafey: Toxicological evaluation of oil residuals on medical implants.

International Chemical Manufacturer: Evaluation of cancer classification systems and setting of occupational exposure limits in European countries and organizations.

Boston Medical Center: Coordination of study of potential effects of perchlorate in humans.

Zinc Corporation of America: Risk assessment using both environmental and epidemiological data for lead and cadmium in soil at a Superfund site.

Major Canadian Mining Company: Evaluation of arsenic exposure at mining/milling site using biological monitoring, risk assessment for arsenic, and communication with the public and regulatory agencies.

McLane: Evaluation of toxicological effects from acute exposures to ammonia.

Law Firm Representing Midwest Utility: Prepared report regarding historic knowledge of toxicity of simple and complex cyanides, and of oxide box waste materials at former MGP sites. Prepared risk assessment for site.

Kelley, Drye and Warren: Evaluation of toxicology of mineral spirits.

U.S. Department of Justice: Development of sampling plan and risk assessment for spray drift exposure to pesticides.

U.S. Dept. of Navy: Risk assessment for volatiles released from waste water treatment plant.

Anderson, Kill & Olick: Assessment of toxicity and risks of MTBE.

Law Firm Representing Smelter Owner: Evaluated health protectiveness of state cleanup levels for arsenic, lead, and cadmium in soil in class action case.

Law Firm Representing Municipality And Port Authority: Prepared risk assessment for proposed development at former MGP site, evaluating future exposures to construction workers and residents. Developed risk-based remedial targets.

Major Mining Company: Review of historical toxicological knowledge of lead.

Law Firms Representing Multiple PRPs at site involving groundwater : Evaluation of historical uses, and standards and criteria for trichloroethylene.

American Cyanamid: Development of risk screening process for evaluating potential hazards at international sites as part of property transfer.

Major Consumer Product Manufacturer: Development and application of adult blood lead model to predict blood lead levels from discontinuous exposures to lead released from a consumer product.

Conestoga - Rovers & Associates: Evaluation of methodologies and assumptions used by EPA and other investigators to estimate risks from polychlorinated biphenyls in soils and sediments, with particular emphasis on dermal absorption.

Health Effects Institute: Assessment of literature on carcinogenicity of inhaled diesel exhaust particulates, especially using urine mutagenicity. Review of literature on toxicity of carbon monoxide and effects on individuals with angina.

Massachusetts Attorney General: Expert witness testimony on the use of risk assessment for the siting of an energy facility.

Buckman Chemical Company: Review of toxicity of barium compounds in cost allocation project.

Lead Industries Association: Critique of HUD cost benefit analysis on apartment deleading.

Engineering Company: Risk assessment for lead, asbestos, PCBs and other chemicals in soil and water at former brake lining manufacturing facility.

Nugent, Fitzgerald, McGroarty & McFadden: Risk support at multiple MGP sites including evaluation of potential risks from VOCs in groundwater and evaluation of potential risks to workers from PAHs in soil.

Battery Manufacturing Company: Development and oversight on sample collection and analysis program for lead exposure, evaluation of existing blood lead and tooth lead data and application of blood lead model.

ARCO/Denver: Risk assessment support for several major mining-related Superfund sites in the western U.S. Evaluation of toxicology, epidemiology, and bioavailability of metals, including lead, arsenic, and cadmium.

International Lead Zinc Research and Organization: Development of probabilistic blood lead model.

Chemical Manufacturer: Toxicology assessment for organo-tin compounds.

Marine Shale Processors: Risk assessment of lead, other inorganics and organic compounds in aggregate produced by hazardous waste recycling. Evaluation of risks of air emissions during incineration process.

American Red Cross: Review of toxicity of new blood bag plasticizer and assessment of potential risks to blood product recipients.

Remedial Trust representing Consortium of PRPs: Evaluation of university and agency research plans involving groundwater modeling and remedial approaches at former manufacturing site. Evaluation of biomonitoring approaches for metals. Evaluation of risk assessment for site.

Coalition for Clean Air Act Implementation: Evaluation of technical issues, including use of composite scores, in 112(g), trading of hazardous air pollutants. Quantification of uncertainty in the composite source.

Golden and Mandel: Review of toxicology of atmospheric sulfuric acid.

Canadian Mining Company: Arsenic risk assessment at tailings site. Risk assessment for multiple metals associated with tailings release at mine in Southeast Asia.

Gorman, Waszkiewicz: Litigation support case involving alleged residential exposure to municipal landfill chemicals.

Horsehead Industries: Evaluation of multipathway risks associated with slag use. Critique of EPA Hazardous Waste Identification Rule.

ARCO/Los Angeles: Preparation of technical comments on toxicological evaluation and risk assessment used for listing of lead by Cal EPA as toxic air pollutant.

Consortium of Massachusetts Utilities: Review of toxicological knowledge of chemicals at manufactured gas plant sites over time for Massachusetts generic rate setting case.

DyKema & Gossett: Evaluation of non-cancer risks from alkylphenols in groundwater at a wood tar site, based on structure activity relationships. Evaluation of risks from polycyclic aromatic hydrocarbons.

Region I EPA: Compilation and review of air toxics monitoring studies in Region I with respect to adequacy in reflecting human exposure and in identifying relevant sources from a risk perspective.

Haley & Aldrich: Risk assessment for volatile chemicals possibly entering a building, due to site remediation.

Syntex Corporation: Critique of Federal Register notice on delisting of incinerator ash from RCRA regulations. Reviewed applicability of model to dioxin contaminated ash.

Occidental Petroleum: Risk assessment for volatile compounds, polycyclic aromatic hydrocarbons, and metals in air, soil, and water associated with historic refinery operations and with natural gas and petroleum formations.

American Lung Association of Maine: Technical advice on health effects of criteria and non-criteria air pollutants. Review of regulatory packages.

Northeast States for Coordinated Air Use Management: Technical assistance in organizing conference on use of bioassays in evaluating ambient air pollutants and presentation of report on use of short-term pulmonary bioassays in evaluation of toxicity and potential health effects of urban particulates.

ENSAFE: Risk assessment for metals in soil at U.S. Navy shipyard for RCRA clean closure.

N.J. Dept. of Environmental Protection: Site assessment and risk assessment for specialty chemical manufacturing site in N.J. involving volatile organic chemicals and DDT.

EPA/Mathtech: Development of work plan to conduct morbidity or mortality study, using readily available data bases, for high ozone levels experienced in summer of 1988.

Davis, Graham & Stubbs: Risk assessment for arsenic-contaminated soil. Assessed human health risks via inhalation and ingestion and ecological risks to deer populations.

Bridgewater Energy Center: Review of regulations regarding disposal of incinerator ash. Also reviewed air emissions from RDF facilities in comparison with emissions from traditional incinerators.

Oil Refinery: Ecological and human health risk assessment for solvent extracted soils originally contaminated with petroleum waste, based on potential to contaminate nearby harbor in New Jersey.

Gas Research Institute: Assistance in preparation of exposure manual for MGP sites.

Publications – *Articles*

Beck, BD. 2005. "An evaluation of the EPA definition of a Risk Assessment". *Belle Newsletter.* 13(1):4-6.

Long, CM; Seeley, M; Beck, BD. [Gradient Corp.]. 2005. "Tiny particles, large data gaps: A risk assessment perspective on nanotechnology." *Risk Policy Rep.* 12 (13):12-14.

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Goering, PL; Aposhian, HV; Mass, MJ; Cebrian, M; Beck, BD; Waalkes, M. 1999. The enigma of arsenic carcinogenesis: role of metabolism. *Toxicological Sciences* 49:5-14.

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Valberg, PA; Beck, BD; Boardman, PD; Cohen, JT. 1998. Likelihood ratio analysis of skin cancer prevalence associated with arsenic in drinking water in the USA. *Env. Geochemistry and Health* 20(2):61-66.

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Beck, BD. 1997. The use of information on susceptibility in risk assessment: state of the science and potential for improvement. *Environ. Toxicol. and Pharm.* 4(4):229-234. December.

Chappell, WR; Beck, BD; Brown, KG; Chaney, R; Cothern, CR; North, KJ; Thornton, I; Tsongas, TA. 1997. Inorganic arsenic: a need and an opportunity to improve risk assessment. *Env. Health Perspect.* 105(10):1060-1067. October.

Foster, SJ; Beck, BD. 1996. Basement gas: issues related to the migration of potentially toxic chemicals into house basements from distant sources. *Toxicology and Industrial Health* 12(2):165-177.

Brown, KG; Beck, BD. 1996. Arsenic and bladder cancer mortality. *Epidemiol.* 7:557-558.

Slayton, TM; Beck, BD; Reynolds, KA; Chapnick, SD; Valberg, PA; Yost, LJ; Schoof, RA; Gauthier, T; and Jones, L. 1996. Issues in arsenic cancer risk assessment. *Env. Health Perspect.* 104:2-4.

Brain, JD; Blanchard, JD; Heyder, J; Wolfthal, SF; Beck, BD. 1996. Relative toxicity of di(2-ethylhexyl) sebacate and related compounds in an *in vivo* hamster bioassay. *Inhal. Toxicology* 8:579-593.

Shifrin, NS; Beck, BD; Gauthier, TD; Chapnick, SD;. Goodman, G. 1996. Chemistry, toxicology, and human health risk of cyanide compounds in soils at former manufactured gas plant sites. *Regul. Toxicol. Pharmacol.* 23:106-116.

Rudel, R; Slayton, TM; Beck, BD. 1996. Implications of arsenic genotoxicity for dose-response of carcinogenic effects. *Regul. Toxicol. Pharmacol.* 23:87-105.

Sexton, K; Beck, BD; Bingham, E; Brain, JD; DeMarini, DM; Hertzberg, RC; O'Flaherty, EJ; Pounds, JG. 1995. Chemical mixtures from a public health perspective: the importance of research for informed decision making. *Toxicology* 105:429-441.

Beck, BD; Boardman, PD; Hook, GC; Rudel, RA; Slayton, TM; Carlson-Lynch, RA. 1995. Response to Smith *et al. Env. Health Perspect.* 103(1):15-17.

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Carlson-Lynch, H., B.D. Beck, and P.D. Boardman. 1994. Arsenic risk assessment. *Env. Health Pers.* 102(4):354-356.

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Publications – *Abstracts*

Lewandowski, T.; B. Beck; L. Beyer and L. Rhomberg. 2005. A Historical Perspective on Long-Term Animal Bioassays. Presented at SOT 44th Annual Meeting, New Orleans, LA.

Schettler, S.; M. Seeley; T. Lewandowski and B. Beck. 2005. Perinatal Perchlorate Exposure in the Rat: Does Thyroid Status Affect Brain Morphometry? Presented at SOT 44th Annual Meeting, New Orleans, LA.

Beyer, L. and B. Beck. Glass Bead Inhalation and Induction of Silicosis. 2005. Presented at SOT 44th Annual Meeting, New Orleans, LA.

Seeley, M.; C. Wells; S. Ren and B. Beck. 2005. Determining Soil Remedial Action Criteria for Acute Effects: The Challenge of Copper. Presented at SOT 44th Annual Meeting, New Orleans, LA.

Schoen, A. and B. Beck. 2005. The Role of Methylated Metabolites in Inorganic Arsenic-Induced Cancer: A Synthesis of Information from In Vitro and Human Biomonitoring Studies. Presented at SOT 44th Annual Meeting, New Orleans, LA.

Beyer, L., M. Seeley, and B. Beck. 2004. Evaluation of Exposure to Metals on Reusable Shop Towels. *The Toxicologist* 78(S-1):107.

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Beyer, L., B. Beck, and K. Chan. 2002. Assessment of "all cancers" in dioxin epidemiology studies. *The Toxicologist* 66(1):158.

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Seeley, M.R., B.D. Beck, L.E. Tonner-Navarro, and R. Deskin. 2000. European differences in derivation of occupational exposure levels. *The Toxicologist* 54(1):274.

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Slikker, W. and B.D. Beck. 1999. Cognitive tests: interpretation for neurotoxicity? *The Toxicologist* 48(1-S):2-3.

Beck, B.D. and T.M. Slayton. 1998. Impact of arsenic (As_i) metabolism on human populations: dose-response relationships in arsenic-induced cancers. *The Toxicologist* 42(1-S):354.

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Beck, B.D., L.A. Beyer, C. Price, J. Robertson, and D. Hiller. 1998. An exposure assessment for inorganic arsenic in vegetables using site-specific data from a tailings site in Ontario. Presented at the Third International Conference on Arsenic Exposure and Health Effect, San Diego, CA.

Beyer, L.A. and B.D. Beck. 1997. Key issues raised by EPA's proposed ozone standards and supporting analysis. Presented at the 1997 Society For Risk Analysis Annual Meeting and Exposition, Washington, DC.

Cohen, J.T., M.A. Lampson, and B.D. Beck. 1997. Use of a Monte Carlo exposure model to estimate blood lead distributions in U.S. children. *The Toxicologist* 36:337-338.

Cohen, J.T., B.D. Beck, and T.S. Bowers. 1996. Validation of an arsenic model through urine and fecal measurements. *The Toxicologist* 30:49.

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Slayton, T.M., B.D. Beck, and P.A. Valberg. 1995. Evaluation of health effects resulting from accidental exposures. Presented at 1995 Air and Waste Management meeting.

Beck, B.D., P.D. Boardman, and A. Watson. 1995. Urinalysis study for evaluating arsenic exposure in a population residing on mill tailings. *The Toxicologist* 15:87.

Beck, B.D., G. Goodman, and T.D. Gauthier. 1994. Risk assessment for cyanides in soil at manufactured gas plant (MGP) sites. *The Toxicologist* 14:154.

Schoof, R.A., L.J. Yost, P.A. Valberg, and B.D. Beck. 1994. Recalculation of the oral arsenic reference dose and cancer slope factor using revised assumptions in inorganic arsenic intake from food. *The Toxicologist* 14:37.

Bowers, T.S., A.R. Michelson, and B.D. Beck. 1994. Short-term lead exposure modeling. *The Toxicologist* 14:36.

Beck, B.D. and T.S. Bowers. 1993. Uptake of Pb into the body: geochemical characteristics affecting uptake, host modifying factors, and approaches to quantify. *Proceedings of the 1993 Annual Meeting of the Geological Society of America.*

Karam, H.S., B.D. Beck, G. Goodman and M.J. Steele. 1993. The value of blood lead measurements in children in estimating past, present, and future exposures to lead: Application to risk management decisions at Superfund sites. *The Toxicologist* 13(1):302.

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Beck, B.D. and M.L. Dourson. 1992. Improvements in quantitative noncancer risk assessment: Introduction. *The Toxicologist.* 12(1):23.

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Petito, C.T. and B.D. Beck. 1990. Evaluation of non-linearities in the dose response curve for arsenic carcinogenesis. *Proceedings of the 24th Annual Conference on Trace Substances in Environmental Health.*

Beck, B.D. and J.D. Brain. 1988. Application of short-term lung bioassays to risk assessment for metals. *The Toxicologist.* 8:154.

Beck, B.D. and P.Y. Tsai. 1987. Risk assessment for lead contaminated soil. *The Toxicologist.* 7:729.

Beck, B.D., J.D. Brain, S.F. Wolfthal, J. Zibrak, and S. Sommers-Smith. 1985. Possible sources of biochemical indicators of lung injury in bronchoalveolar lavage fluid from hamsters. *Am. Rev. Respir. Dis.* 131:A184.

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Beck, B.D., J.D. Brain, and S.F. Wolfthal. 1984. Are combustion products of automobile waste oil (AWO) toxic to the lungs? *Am. Rev. Respir. Dis.* 129:152.

Beck, B.D., J.D. Brain, and N.S. Shera. 1983. Acute indicator of lung damage in hamsters exposed to bleomycin plus 70% O2 or elastase. *Am. Rev. Respir. Dis.* 127:171.

Beck, B.D., B. Gerson, H. Feldman, and J.D. Brain. 1982. LDH isoenzymes in hamster lung lavage fluid as a means of assessing pulmonary damage. *Am. Rev. Respir. Dis.* 125:230.

Beck, B.D., J.D. Brain, and D.E. Bohannon. 1982. Are respirable combustion products from home heating stoves toxic to the lungs? *Am. Rev. Respir. Dis.* 125:156.

Beck, B.D., J.D. Brain, and D.E. Bohannon. 1981. Will Mt. St. Helens volcanic ash injure the lungs? *Am. Rev. Respir. Dis.* 123:149.

Beck, B.D. and J.T. Park. 1970. Study on the relationship between three murein hydrolases and cell division in *E. coli*. *Annu. Meeting Amer. Soc. Microbiol.* G38:26.

Publications – *Other Publications/Reports*

Valberg, P.A., B.D. Beck. 1993. "Recalculation of the Arsenic Cancer Slope Factor." Submitted to IRIS Information Submission Desk (U.S. EPA) on August 9, 1993.

Beck, B.D., G. Goodman, and C.P. Hemphill. 1993. "Summary of Naphthalene Toxicity Information and Derivation of a Naphthalene Oral RfD." Draft report excerpt submitted to U.S. EPA Naphthalene RfD Work Group. August 30.

Beck, B.D. 1987. "Acute and Chronic Toxicity of Trichloroethylene," "Non-Carcinogenic Risk Assessment," "The Role of Peroxisomal Proliferation in Trichloroethylene Hepatotoxicity and Carcinogenicity." Draft NESCAUM (Northeast States for Coordinated Air Use Management) Health Assessment Document.

Beck, B.D. 1982. The Use of Bioassays to Assess the Toxicity of Particulates; Evaluation of Bioassays. In *Appendix 2: Toxic Effects of Airborne Particulates*, pp 119 - 167, Appendix to Report "Analysis of Health Effects Resulting from Population Exposures to Ambient Particulate Matter" Prepared by Harvard University, Energy and Environmental Policy Center, for U.S. Dept. of Energy, Agreement No. DE-AC02-81EV10731.

Beck, B.D. 1975. *Activity of Three Murein Hydrolases During the Cell Cycle of Escherichia coli. K-12.* Ph.D. dissertation, Tufts University, Medford, MA.

Invited Lectures/Other Presentations – *1985 – Present*

03/05 – "The Life of A Consultant." Society of Toxicology 44th Annual Meeting, New Orleans, LA.

11/04 – "Arsenic Methylation: Considerations for Risk Assessment." University of Alberta, Environmental Health Sciences Seminar, Edmonton, AB.

03/04 – "Arsenic Methylation: Considerations for Risk Assessment." Society of Toxicology 43rd Annual Meeting, Baltimore, MD.

01/04 – "Lack of Relevance of DMA-Induced Rat Bladder Tumors for Human Risk Assessment: Metabolism and Disposition Studies of DMA and MMA." Presented to Office of Pesticide Programs, EPA, Washington, DC.

12/03 – "Selected Comments on Draft EPA Exposure & Risk Assessments for CCA-Treated Wood Using SHEDS-Wood Model." Presented at FIFRA SAP Meeting, Washington, DC.

11/03 – "Risk Assessment: An Overview." University of Connecticut, School of Pharmacy, Storrs, CT.

10/03 – "Comparison of a Probabilistic/Mechanistic Approach to a Deterministic/Empirical Approach for Evaluating CCA-Treated Wood Exposures." Presented at 19th Annual International Conference on Soils, Sediments and Water, Amherst, MA.

4/03 – "Evaluation of Potential Human Health Risks from Copper Azole-Treated Wood." Presented at 99th Annual Meeting of the American Wood-Preservers' Association, Boston, MA.

11/02 – "A Case Study of Arsenic Risk Assessment and Risk Management." Presented at NIEHS DERT Science Retreat, Wilmington, NC.

10/02 – "CCA-Treated Wood: Science and Politics." Presented at University of Massachusetts, Amherst.

10/02 – "Research Activities to Refine Human Health Risk Assessment for CCA-Treated Wood." Presented to CPSC, Washington, DC.

8/02 – "Comments on EPA Background Documents Regarding SHEDS-Wood Model." Presented at Science Advisory Panel meeting, Washington, DC.

1/02 – "Principles of Toxicology." Harvard School of Public Health, Boston, MA.

12/01 – "Risk Assessment: An Overview." University of Connecticut, School of Pharmacy, Storrs, CT.

10/01 – "Comments on EPA Background Documents Regarding CCA-Treated Wood." Presented to Scientific Advisory Panel, Washington, DC.

10/01 – "Statement by Barbara D. Beck re: Arsenic in drinking water: An update on the science, benefits and cost." Presented at Congressional Hearing, Washington, DC.

8/01 – "Focused Evaluation of Health Risks from Exposure to Arsenic Associated with CCA-Treated Wood." Presented to Consumer Product Safety Commission, Washington, DC.

6/01 – "Adult : Child Differences in the Intra-Species Uncertainty Factor: A Case Study Using Lead." Presented at the Fifth Annual Workshop on Evaluation of Default Safety Factors in Health Risk Assessment, UMDNJ-New Jersey Medical School, Newark, NJ.

3/01 – "Risk Assessment for Metals: Physiologically-Based Pharmacokinetic Models for Metals." Society of Toxicology 40th Annual Meeting, San Francisco, CA.

6/00 – "EPRI-Sponsored Arsenic Research Program - Application to Arsenic Cancer Risk Assessment." SEGH Fourth International Conference on Arsenic Exposure and Health Effects, San Diego, CA.

5/00 – Invited participant/speaker to The Fourth Annual Workshop on Evaluation of Uncertainty/Safety Factors in Health Risk Assessment, Nutley, NJ.

4/00 – "Development of a Stochastic Physiologically-Based Pharmacokinetic Model for Lead." Toxicology and Risk Assessment Approaches for the 21st Century Conference, Kings Island, OH.

6/99 – "The Development of a Stochastic Physiologically-Based Pharmacokinetic Model for Lead." EPA Workshop on Lead Model Development: Probabilistic Risk Assessment and Biokinetic Modeling, Raleigh-Durham, NC.

6/99 – "The Development of a Stochastic Physiologically-Based Pharmacokinetic Model for Lead." WHO/IARC Conference on Lead Exposure, Reproductive Toxicity and Carcinogenicity, Gargnano, Italy.

3/99 – "Strategies for Prosecuting and Defending Toxic Tort Litigation - A Toxicologist's Perspective." ABA Annual Conference on Environmental Law, Keystone, CO.

3/99 – "Principles of Toxicology." Harvard Center for Risk Analysis Course on "Analyzing Risk: Assessment and Management." Boston, MA.

2/99 – "Comments on EPA Perchlorate RfD Draft Document." Perchlorate Peer Review Workshop, San Bernardino City Council Chambers, San Bernardino, CA.

1/99 – "Risk Assessment: An Overview." Harvard School of Public Health Principles of Toxicology Course, Boston, MA.

12/98 – "Risk Assessment: An Overview." University of Connecticut Advanced Toxicology Course, Storrs, CT.

11/98 – "EPA's Proposed Residential Lead Standards." EPA's Children's Health Protection Advisory Committee Meeting, New Carrolton, MD.

10/98 – "What are the Characteristics of a Well-designed Environmental Lead/Blood Lead Study?" National Environmental Policy Institute's Conference on "Protecting Children's Health: Assessing the Relationship of Soil Lead to Blood Lead." Washington, DC.

10/98 – "Principles of Toxicology." Harvard Center for Risk Analysis Course on "Analyzing Risk: Assessment and Management." Boston, MA.

10/98 – "Cumulative Risk - Case Study." American Law Institute-American Bar Association Course of Study, "Risk Assessment and Risk Management in Environmental Law." Washington, DC.

10/98 – "Introduction to Recent Developments in Risk Assessment: Aggregate Exposure and Cumulative Risk." American Law Institute-American Bar Association Course of Study, "Risk Assessment and Risk Management in Environmental Law." Washington, DC.

4/98 – "Principles of Toxicology." Harvard Center for Risk Analysis Course on "Analyzing Risk: Assessment and Management." Boston, MA.

3/98 – "Impact of Arsenic (As_i) Metabolism on Human Populations: Dose-Response Relationships in Arsenic-Induced Cancers." Society of Toxicology 37th Annual Meeting, Seattle, WA.

3/98 – "Effective Risk Communication: Avoiding the Pitfalls." Continuing Education Course, Society of Toxicology 37th Annual Meeting, Seattle, WA.

12/97 – "Key Issues Raised by EPA's Proposed Ozone Standards and Supporting Analysis." Society for Risk Analysis, Annual Meeting and Exposition, Washington, DC.

5/97 – "Testimony on Analysis of Risk Assessment Used by the EPA in Support of Its Proposed Ozone Standards." Before the Joint Hearing of the Health and Environment Subcommittee and the Oversight and Investigations Subcommittee, Commerce Committee, U.S. House of Representatives, Washington, DC.

3/97 – "Principles of Toxicology." Harvard Center for Risk Analysis Course on "Analyzing Risk: Assessment and Management." Boston, MA.

12/96 – "Risk Assessment for Criteria Pollutants *versus* Other Noncarcinogens: The Difference Between Implicit and Explicit Conservativism." Rutgers University 2nd Annual Workshop on "The Evaluation of EPA 10X Safety Factors in Health Risk Assessment." Nutley, NJ.

9/96 – "The Quantitative Use of Information on Susceptibility in Risk Assessment: Where is it Working or Not Working? How Can We Make It Better?" Third Annual NHEERL Symposium on Susceptibility and Risk Assessment. Raleigh, NC.

9/96 – "Principles of Toxicology." Harvard Center for Risk Analysis Course on "Analyzing Risk: Assessment and Management." Boston, MA.

8/96 – "The Role of Risk Assessments in Superfund." American Bar Association, Orlando, FL.

12/95 – "Use of Monte Carlo Arsenic (As) Model to Predict Distributions of Urine Arsenic at a Mining and Milling Site." Society for Risk Analysis, Honolulu, HI.

10/95 – "Use of Information on Variations in Susceptibility - Ozone." ILSI Risk Science Institute Workshop on Human Variability, Washington, DC.

10/95 – "Evaluation of Health Effects Resulting from Accidental Exposures." Michigan Society for Risk Analysis, Dearborn, MI.

9/95 – "Principles of Toxicology." Harvard Center for Risk Analysis Course on "Analyzing Risk: Assessment and Management", Boston, MA.

6/95 – "Validation of an Arsenic Exposure Model at a Mining and Milling Site through Urinalysis." "Use of an Arsenic Exposure Model at a Gold Mining and Milling Site." Second International Conference on Arsenic Exposure and Health Effects, San Diego, CA.

7/94 – "A Review of Scientific Issues Pertaining to Arsenic." Society for Environmental Geochemistry and Health Conference on Lead and Arsenic Exposure in the Rocky Mountains, Salt Lake City, UT.

5/94 – "Use of Lead Exposure Assessment in the Regulatory Process." International Lead Zinc Research Organization Lead Exposure Assessment Workshop, Research Triangle Park, NC.

3/94 – "Non-linearities in Arsenic Risk Assessment." Boston Risk Assessment Group, Cambridge, MA.

3/93 – "Basic Risk Assessment: Current Developments": Continuing Education Course, Society of Toxicology, New Orleans, LA.

3/92 – "A Review of the Bioavailability of Petroleum Constituents." West Coast Soils and Groundwater Conference, Long Beach, CA.

3/92 – "Bioavailability of Metals and Organics." Workshop on Human Health and Ecological Risk Assessments for Contaminated Sites, Toronto, Canada.

2/92 – "Improvements in Quantitative Noncancer Risk Assessment." Chair of Symposium of Society of Toxicology Meeting, Seattle, WA.

2/92 – "Perspectives on the Development of Soil Cleanup Levels at Mining Sites." Colorado Bar Association. Denver, CO.

11/91 – "Environmental Law Update: Toxic Torts and How Clean is Clean?" Squire, Sanders & Dempsey, Cincinnati, OH.

10/91 – "Risk Assessment for Indoor Air: Evaluating Risks to Susceptible Populations." NATO/CCMS-COST 613 Joint Workshop, Kloster Banz, Bavaria, Germany.

2/91 – "An Update on Exposure and Risks of Lead." Chair of Symposium at Society of Toxicology Meeting.

2/90 – "Inhalation Risk Assessment." Chair of Symposium at Society of Toxicology meeting.

1/90 – "The Use of Structure Activity Relationships for Alkyl Phenol Risk Assessment" New England Society for Risk Analysis, Boston, MA; RJR/Nabisco, Winston-Salem, NC.

1/90 – "The Use of Structure Activity Relationships in Risk Assessment" Harvard School of Public Health, Boston, MA; Northeastern University, Boston, MA.

11/89 – "How Protection Levels are Developed and What They Mean," Course on Risk Assessment and Epidemiology for Lawyers, Harvard School of Public Health, Boston, MA.

9/89 – "An Environmental Health Case Study," Tufts Medical School, Boston, MA.

3/89 – "Impact of Lead Derived from Mining Sources on Blood Lead," Boston Risk Assessment Group, Boston, MA.

2/89 – "Ecological and Health Risk assessment for Arsenic in Soil," Society of Toxicology, Atlanta, GA.

12/88, 1/89, 9/89, 10/89 and 4/90 – "Risk Assessment for Hazardous Waste Sites, Including a Perspective on Toxic Torts." Executive Enterprises, Inc., Washington, DC, Chicago, IL, Philadelphia, PA, and Orlando, FL.

10/88 – "Ozone Toxicology and Risk Assessment," Harvard School of Public Health, Boston, MA.

10/88 – "Risk Assessment for Arsenic in Soil," University of Massachusetts, Amherst, MA.

9/88 – "The Use of Animal Bioassays to Assess Lun20 Toxicity," NESCAUM, Princeton, NJ.

6/88 – "Review of Epidemiological and Toxicological Studies on Mining Derived Lead," EPA, Philadelphia, PA.

3/88 – "Assessment of Impact on Blood Lead of Lead from Mining Sources," EPA, Washington, DC.

2/88 – "Regulatory Toxicology," Tufts University School of Medicine, Boston, MA.

12/87 – "Risk Assessment for Soil," Harvard School of Public Health, Boston, MA.

12/87 – "Health Effects of Ozone and the Clean Air Act," New England Chapter for Society for Risk Analysis, Cambridge, MA.

11/87 – "Health Effects of Ozone," Harvard School of Public Health, Boston, MA.

9/87 – "Health Risk Assessment for Soil," University of Massachusetts, Amherst, MA.

4/87 – "Key Issues in Addressing Adverse Effects of Ozone," University of Massachusetts, Amherst, MA.

1/87 -- "Risk Assessment for Dioxin in Soil," MIT, Cambridge, MA.

10/86 – "Pulmonary Toxicology," Harvard School of Public Health, Boston, MA.

10/86 – "Risk Assessment," University of Massachusetts, Amherst, MA.

10/86 – "Regulatory Toxicology," Tufts University School of Medicine, Boston, MA.

7/86 – "Health Effects of Indoor Air Pollutants," Region I, EPA, Lexington, MA.

6/86 – "Health Effects of Radon," Society of Women Engineers, Hartford, CT.

6/86 – "Contacting the Health and the Medical Community About the Adverse Effects of Ozone," EPA, Washington, DC.

6/86 – "Animal Toxicology," Region I EPA, Boston, MA.

4/86 – "Health Effects of Ozone," NESCAUM meeting, Newport, RI.

2/86 – "Pulmonary Toxicology," Region I EPA, Boston, MA.

12/85 – "Toxicology of Dioxin," EPA Dioxin workshop, Lexington, MA.

11/85 – "Animal Bioassays," Harvard School of Public Health, Boston, MA.

11/85 – "Pulmonary Toxicology," Harvard School of Public Health, Boston, MA.

10/85 – "Indoor Air Pollution," Air Pollution Control Association meeting, Enfield, CT.

1/85 – "Indoor Air Pollution," NESCAUM workshop, Northampton, MA.

Editor

1995 to present. *Human and Experimental Toxicology* (Editorial Board)

1991. *Trace Substances in Environmental Health: Supplement to Volume 14 (1992) of Environmental Geochemistry and Health. Proceedings of the 25th Annual Conference on Trace Substances in Environmental Health*, May 20-23, Columbia, MO.

Reviewer

Fundamental and Applied Toxicology; Toxicological Sciences; Cancer Research; Environmental Research; Annals of Internal Medicine; Human and Ecological Risk Assessment; Journal of Society of Environmental Geochemistry and Health; Human and Experimental Toxicology; Environmental Health Perspectives.

Continuing Education Courses

- Fundamentals of Nanotechnology: Chemistry, Exposure, Environmental/Health Assessments and Societal Impacts, Society of Toxicology, 2005.
- Integrating Toxicologic Pathology into Compound Evaluation and Risk Assessment, Society of Toxicology, 2002.
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- Environmental Toxicology, Society of Toxicology, 1991.
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- Toxicity of Agents: Pesticides, Society of Toxicology, 1990.
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- Respiratory Tract Toxicology by Classes of Agents, Society of Toxicology, 1988.
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- Pulmonary Pathophysiology, University of Vermont Medical School, 1979

Comments on USEPA's June 2005 Proposed Plan

Multiple Source Groundwater Response Plan Study Area

Woburn, Massachusetts

August 31, 2005

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1.0 Comments on Human Health Risk Assessment

This section presents ENSR International's comments on the Draft Baseline Human Health Risk Assessment Report for the Multiple Source Groundwater Response Plan (MSGRP) Northern Study Area (the MSGRP HHRA) (USEPA, 2005a). Many issues were identified, and the comments focused on the scenarios and constituents that are the risk-drivers and therefore formed the basis for the Feasibility Study (FS) and Proposed Plan.

USEPA Risk Characterization Guidance discusses the importance of the "core values of transparency, clarity, consistency, and reasonableness" in risk assessments, and stresses that assumptions used should fall within a "zone of reasonableness" (USEPA, 1995a). The MSGRP HHRA has not been conducted consistent with these guidelines and has used unrealistic exposure scenarios and overly-conservative exposure parameters. This risk assessment should serve only as an interim step in the evaluation of risks potentially posed by the site. Once the risk drivers were identified, the exposure scenarios should have been reviewed and re-evaluated using more realistic and reasonable exposure scenarios and assumptions. As discussed in detail below, the combination of several upper bound assumptions serves only to overly exaggerate risk; any single upper-bound assumption coupled with more reasonable assumptions will still result in upper-bound risk estimates. Therefore, USEPA should not make risk management decisions and propose remedial actions until the HHRA is revised to use a more realistic and reasonable approach, as detailed below:

Exposure to Groundwater

- **The use of groundwater in a car wash scenario should not have been included in the risk assessment as a complete exposure pathway based on City of Woburn zoning and groundwater use restrictions.**
- **Future use of groundwater as industrial process water should be identified as an incomplete pathway, and no risks or hazards should be calculated for this scenario, because special permits are required for well installation in Woburn and wells can not be installed on hazardous waste sites.**
- **Ingestion of shallow groundwater during excavation activities should not be identified as a complete exposure pathway, and no risks or hazards should be calculated for this pathway because a construction worker will not ingest shallow groundwater at a rate of 50 ml per day, which is the high intensity water ingestion rate assumed for a swimming scenario.**
- **Considering reasonable future use of groundwater, the potential for vapor intrusion, and the potential for future excavation and construction work within the MSGRP Northern Study Area, no groundwater exposure pathways result in risks or hazards above regulatory guidelines. No remedies for groundwater need to be addressed in either the FS or the Proposed Plan.**

Exposure to Soil

- **Use of the more realistic, yet upper-bound, soil ingestion rate of 100 mg/day for the construction worker would result in a 2-fold reduction in risk and hazard estimates for this pathway. Coupled with the use of the arsenic bioavailability factor for soil ingestion (resulting in an additional 2-fold reduction in ingestion risk and hazard estimates), and elimination of the shallow groundwater ingestion pathway, the resulting potentially carcinogenic risks would not exceed the regulatory guidelines for the construction worker, and the hazard index would be only slightly above the regulatory guideline of 1 for the SO (Former Mishawum Lake and associated wetlands) subsurface soil exposure area, and would be below the regulatory guideline for the SO surface soil exposure.area.**

- Excavation restrictions for construction workers exposed to subsurface soils in the SO area should be based on a 1,000 mg/kg PRG for arsenic, which was derived using more realistic, yet still conservative, exposure factors than used by USEPA.

- Application of more realistic and reasonable exposure parameters for a future day care child assumed to be exposed to arsenic in surface soils in the SO area would result in a hazard index that is below regulatory guidelines. Since the potential carcinogenic risk level is already below regulatory guidelines, no remedial action would be necessary or appropriate for surface soils.

- USEPA's hazard index and potential carcinogenic risk estimates for a future day care child exposed to subsurface soils in the SO area are based on the highly unrealistic assumption that all of the subsurface soil in the study area would one day be brought to the surface and that the 95% upper confidence limit (UCL) concentration would occur precisely in a child's play area. If USEPA's exposure assumption is correct, there should be little or no difference in surface and subsurface soil concentrations as a result of development. However, this is not the case. The majority of the property in the study area is developed, i.e., already subjected to construction and reworking of subsurface soils, yet the subsurface soils (Exposure Point Concentration (EPC) = 1,900 mg/kg) still have higher concentrations than surface soils (EPC = 92 mg/kg). For this reason, this exposure pathway should be considered incomplete.

Exposure to Sediments

- To identify a hazard index and a potential carcinogenic risk above regulatory guidelines, USEPA had to assume that a dredger worked at single location in HBHA Pond for a two-year period and ingested the maximum detected concentration of arsenic at that location at a very high sediment ingestion rate. The resulting exposure point concentration (EPC) for the future dredger scenario is unreasonable, unrealistic and does not reflect the scenario evaluated. Arsenic concentrations, which are the risk driver, are highly variable. It is likely that if the more realistic exposure assumptions and EPCs are used in the MSGRP HHRA, risks for this hypothetical future dredger receptor would not exceed regulatory guidelines. For that reason, risk management decisions should not be made for sediments until the HHRA is revised using more realistic exposure assumptions.

Arsenic Toxicity

- Based on this review of the available scientific data (including numerous studies that have been published since the RfD was last revised), use of a diet-adjusted NOAEL of 0.0024 mg/kg-day (reflecting a NOAEL of 0.0015 mg/kg-day and a dietary intake of 0.0009 mg/kg-day) together with an MOE of 1 represents a conservative (i.e., health-protective) toxicity benchmark (RfD = 0.0024 mg/kg-day) for assessing potential non-cancer health risks associated with long-term exposures. This RfD is 8-fold higher that that developed by USEPA. Use of this value would result in an 8-fold decrease in the calculated hazards in the MSGRP HHRA and would result in an 8-fold increase in the noncancer-based PRGs for arsenic.

- The uncertainties, and high degree of conservatism, in the cancer potency estimates for arsenic provide an additional reason why the MSGRP HHRA should be refined with more realistic exposure assumptions prior to using it as the basis for remedy decisions.

Trichloroethylene Toxicity

- Lewandowski and Rhomberg (2005) recently published an analysis of the USEPA TCE cancer potency range in which they evaluated each of the underlying studies with respect to scientific validity and relevance for risk assessment. Based on their analysis, they identified liver tumors and the epidemiological study of Anttila et al. (1995) as the most reliable and scientifically valid basis for assessing TCE carcinogenicity. Reliance on the liver tumor endpoint was also suggested by the USEPA Science Advisory Board (USEPA, 2002b). In the USEPA's TCE cancer potency range, the Anttila et al. liver tumor data is associated with an oral slope factor of 7×10^{-2} (mg/kg-day)$^{-1}$ and an inhalation unit risk of 9×10^{-7} (ug/m^{3})$^{-1}$. These values are 6-fold and 120-fold lower, respectively, than the values used in the MSGRP HHRA. Because the Anttila et al. values represent a more scientifically defensible starting point for characterizing TCE's carcinogenic potency, the MSGRP HHRA overstates the risks from ingestion of TCE in groundwater and inhalation of TCE in indoor air, notwithstanding that neither of these exposure pathways should be identified as complete within the study area. For this reason, the MSGRP HHRA should be revised using the Anttila et al. values for TCE toxicity if these pathways are not identified as incomplete.

Benzene Toxicity

- Using the most conservative toxicity value for benzene overstated the risks from exposure to benzene. True cancer risk from exposure to benzene cannot be ascertained, even though dose-response data are

used in the quantitative cancer risk analysis, because of uncertainties in the low-dose exposure scenarios and lack of clear understanding of the mode of action. For these reasons, a range of inhalation cancer slope factors for benzene (2.2E-06 ug/m3^{-1} to 7.8E-06 ug/m3^{-1}) and a range of oral cancer slope factors for benzene (1.5E-02 mg/kg-day^{-1} to 5.5E-02 mg/kg-day^{-1}) should be used in the MSGRP HHRA calculations.

1.1 USEPA's Exposure Assumptions are Overly Conservative

The Draft Baseline Human Health Risk Assessment Report for the Multiple Source Groundwater Response Plan (MSGRP) Northern Study Area (MSGRP HHRA) (USEPA, 2005a) was issued by USEPA on June 30, 2005, with comments due to the Agency on August 31, 2005. The MSGRP HHRA used very conservative, and in most cases overly conservative, assumptions to calculate potential human health risk for surface soils, subsurface soils, sediments, surface water, and groundwater. The results indicated that **no** risks or hazards are posed by the environmental media above regulatory guidelines under the current exposure scenarios, where the receptors evaluated include:

- **Current recreational teenager in the Halls Brook Holding Area (HBHA) wetland system;**
- **Current recreational adults and children consuming recreationally caught fish;**
- **Current day care child (within a specific area – note, there is currently no day care facility within the study area);**
- **Current indoor worker (vapor intrusion); and**
- **Current groundskeeper.**

In addition, **no** risks or hazards above regulatory guidelines were identified for the following future use scenarios:

- **Future recreational teenager in the HBHA wetland system, under both baseflow and storm event conditions;**
- **Future groundskeeper;**
- **Future construction worker exposure to surface soils;**
- **Future use of groundwater as industrial process water in the Class A property area; and**
- **Future use of groundwater in a warm water car wash in the Class A property area.**

Of special note is the fact that surface water and accessible surface sediments in the study area did not pose a risk above regulatory guidelines under any scenario.

In keeping with the tiered approach to risk assessment discussed below, because the very conservative assumptions used for these scenarios did not result in risk exceedances, these scenarios do not require further evaluation or comment.

Risks in excess of regulatory guidelines were calculated for the following hypothetical future use scenarios:

- **Future day care child based on exposure to surface and subsurface soils,**
- **Future construction worker based on exposure to subsurface soils and shallow groundwater,**
- **Future industrial worker using groundwater as process water in an open industrial system,**
- **Future car wash worker using groundwater in a hot water car wash facility, and**
- **Future dredger of sediments in the HBHA.**

USEPA guidance for risk characterization (USEPA, 1995a) explicitly states that the "core values of

transparency, **clarity**, **consistency**, and **reasonableness**" need to be used to guide agency risk assessments and risk characterizations. Moreover, the guidance states that USEPA needs to ensure that their core assumptions fall within a "zone of reasonableness." As then-administrator Carol Browner states, "While I believe that the American public expects us to err on the side of protection in the face of scientific uncertainty, I do not want our assessments to be unrealistically conservative. We cannot lead the fight for environmental protection...unless we use common sense in all we do" (USEPA 1995a).

These points are very important, particularly when viewed within the context of the MSGRP HHRA, where overly conservative assumptions about exposure and toxicity were used to develop unrealistic hypothetical future use risk estimates, and these risk results were used directly in the Feasibility Study (FS) (USEPA, 2005b) as the basis for preliminary remediation goal (PRG) development and alternatives development for the Proposed Plan (USEPA, 2005c).

1.2 A Tiered Approach to Risk Assessment was *not* Used

Many federal and state agency programs use a tiered approach to risk assessment. The basis of the tiered approach is that conservative assumptions are employed in the initial tier of the evaluation, and the results are used at the decision point to determine if no action is appropriate, and if not, whether remediation should be pursued, or whether the analysis would benefit from a more detailed or site-specific evaluation in a subsequent tier. All tiers are protective of human health, however, the non-site-specific values utilized in the initial tier are generally based on conservative, "default" exposure factors and reflect the conservatism and uncertainty in the default assessment process. Each successive tier uses increasingly more site-specific information, thereby reducing uncertainty. As described by USEPA, "In a tiered approach, one begins with a fairly simple screening level model and progresses to a more sophisticated and realistic (and usually more complex) models only as warranted by the finding and value added to the decision" (USEPA, 1997a).

Because of the great weight of decision making put on the MSGRP HHRA results as presented, USEPA should not have stopped the risk assessment process at this point. Rather, USEPA should have continued by carefully evaluating the assumptions made in the risk-driving scenarios, and the toxicity and environmental distribution of the risk-driving constituents, and developed more reasonable approaches to evaluating the scenarios and constituents. Both the risk findings and the value that would be added to the decision warrant the further evaluation.

USEPA guidance for risk characterization (USEPA, 1995b) states that strengths and limitations, including uncertainties, need to be clearly identified in the risk assessment. While an uncertainty section was provided in the MSGRP HHRA, it was cursory in nature. The guidance states "Identify those scientific uncertainties that if reduced (e.g., about whether or not we know if the agent causes cancer, about whether or not we know what happens at low doses, that we know the exposure only occurs in certain specific locations) or the policy choices and management decisions that if changed would make a real impact on the risk assessment" (USEPA, 2002a). This would specifically address the **reasonableness** criterion in the USEPA's risk characterization policy.

The comments provided below focus on the constituents and scenarios that are the risk-drivers in the MSGRP HHRA, and provide suggestions for how more reasonable, and yet still health protective, scenarios and assumptions should be used in a further tier of evaluation. Only after this further tier of evaluation is conducted should remedial decisions be made.

1. 3 Reasonable Maximum Exposure Based on Upper Bound Estimates Overpredicts Risk

USEPA has stated that their goal is to develop an estimate of the reasonable maximum (upper-bound) exposure "that is reasonably expected to occur" for the receptors evaluated in the MSGRP HHRA (USEPA, 2005a). Most of the assumptions about exposure and toxicity used in this evaluation are representative of statistical upper-bounds or even maxima for each parameter. However, the end result of combining several such upper-bound assumptions is that the final estimate of potential exposure or potential risk is extremely conservative, and exceeds the criterion of a reasonable maximum exposure estimate.

This is best illustrated by a simple example. Assume that potential risk depends upon three variables (soil consumption rate, constituent concentration in soil and cancer slope factor (CSF)). The mean, 95% upper bound and maximum are available for each variable. One way to generate a conservative estimate of potential risk is to multiply the 95% upper bounds of the three parameters in this example. Doing so assumes that the 5% of the people who are most sensitive to the potential carcinogenic effects of a constituent will also ingest soil at a rate that exceeds the rate for 95% of the population, and that all the soil these people ingest will have a compound concentration that exceeds the concentration in 95% of the soil on site. The consequence of these assumptions is that the estimated potential risk is representative of 0.0125% of the population (0.05 x 0.05 x 0.05 = 0.000125 x 100 = 0.0125%). Put another way, these assumptions overestimate risks for 9,999 out 10,000 people, or 99.99% of the population, and the majority of people will have a much lower level of potential risk. Thus, it produces estimates of potential risk two to three orders of magnitude greater than the risk experienced by the average member of the potentially exposed populations. Even if a single 95% upper bound assumption (for example, the CSF) is combined with average (50^{th} percentile) assumptions for soil concentration and soil ingestion rate, the resulting estimates of potential risk still over predicts risk for 99% of the potentially exposed population (0.05 x 0.5 x 0.5 = 0.0125 x 100 = 1.25%). Even the combination of an upper bound estimate with just one average estimate results in the protection of 97.5% of a population (0.05 x 0.5 = 0.025 x 100 = 2.5%). This very conservative nature of the potential risks estimated by the risk evaluation process is not generally recognized.

Therefore, the use of multiple upper bound assumptions, as has been done in the MSGRP HHRA, substantially overestimates the "average" level and even the reasonable maximum level of potential risk. Having used the 95% upper bound (or sometimes the maximum) environmental medium concentration as the exposure point concentration (EPC) for all of the risk calculations and having used the USEPA-derived toxicity values, which are all upper-bound conservative values, means that all the risk results, regardless of whether the other exposure parameters are averages or upper bounds, will result in exceeding the level of protectiveness sought under USEPA guidance. Therefore, it is reasonable that the exposure parameters used to define the scenarios be based on reasonable and average estimates, not upper bounds. Specific examples of the unnecessary over-conservatism in exposure and toxicity values in the MSGRP HHRA are provided in the discussions below.

1.4 Groundwater Exposure Scenarios

The Massachusetts Department of Environmental Protection's (MADEP) Groundwater Use and Value Determination for the Site and study area supports a low use and value of the groundwater (see Appendix 6M of the MSGRP HHRA). In addition, the MADEP has also provided a classification of the groundwater as a Non-Potential Drinking Water Source Area.

Based on a discussion with Mr. John Fralick, a Health Agent of the Woburn Health Department, special permits are required for well installation within the City of Woburn. The following were provided by Mr. Fralick:

- **Wells and the use of city water are mutually exclusive;**
- **Special permits are required for well installation; and**
- **Wells should not be installed on hazardous waste sites; there are approximately 250 hazardous waste sites in Woburn.**

Based on this information, it is entirely unlikely and unreasonable to assume that well water would be used for any purpose with in the Industri-Plex Site and the MSGRP study area. Therefore, the future groundwater use scenarios (industrial worker process water use and car wash worker) should not be included in the MSGRP HHRA as exposure to groundwater used for industrial or commercial purposes is not a complete exposure pathway.

By reasonably assuming that use of groundwater as industrial process water or as car wash water will not occur in the future, no risks or hazards would be calculated for these scenarios. The only reasonable groundwater exposure scenarios are the potential for vapor intrusion from the subsurface into overlying buildings, and the potential contact by a construction worker with shallow groundwater in an excavation trench.

Vapor intrusion from the subsurface (groundwater or soils) to indoor air, has been directly evaluated by the collection of soil gas samples in the area of the highest volatile organic compound (VOC) concentrations in groundwater. The soil gas data were used to predict maximum indoor air concentrations of VOCs, which were compared to Region 9 preliminary remediation goals (PRGs) for ambient air (a conservative screen for this industrial/commercial area as a 24-hour per day exposure is assumed). All of the concentrations were below the PRGs, and the scenario was not further evaluated in the MSGRP HHRA.

To further illustrate the overly conservative exposure assumptions, the groundwater receptors evaluated by USEPA (future car wash worker, future industrial worker, and future construction worker) are discussed below.

1.4.1 Future Car Wash Worker Groundwater Exposure Scenario

Based on existing administrative controls, a car wash scenario using groundwater should not be included in the MSGRP HHRA. Nonetheless, there are specific issues with the scenario as constructed by USEPA that need to be discussed. The zoning map and supporting information for the City of Woburn (City of Woburn, 2004) indicate that the area encompassed by the Industri-Plex Site and the MSGRP study area are zoned B-I (Business Industrial), I-P (Industrial Park), I-P2 (Industrial Park) and OS (Open Space). Use of a property as a car wash is prohibited in areas zoned I-P, I-P2, and OS (City of Woburn, 2005). Only two small areas are zoned B-I, and for this zoning designation, possible use as a car wash requires a special permit. The two B-I areas are (as shown on the attached zoning map):

- **B-I #1: The area bounded by the southern-most portion of the HBHA to the west, Mishawum Rd. to the south, and Commerce Way to the east, and extending north of Mishawum Rd. approximately 1000 feet (this is basically the area covered by the Woburn Mall); and**
- **B-I #2: The area bounded to the east by Interstate 93, bounded to the north by the Regional Transportation Center (RTC) exit/entrance to Interstate 93, extending approximately 700 feet south on Commerce Way, and from there, east to the terminus of Commonwealth Ave. The B-I designation also includes the area between Interstate 93 and Commonwealth Ave (approximately 700 feet south along Commonwealth Ave.) that encompasses Phillips Pond.**

Therefore, there are only two locations within the Industri-Plex Site and the MSGRP study area where car washes could be located, and only by special permit. B-I #2 is within the area identified in the MSGRP HHRA as Class A property (the Class A wells located within B-I #2 are CA-07, B5-05, CA-08, B5-04 and CA-09 – see Figure 5 of the MSGRP HHRA; USEPA, 2005a). The risk assessment concluded that the Class A property wells did not pose a risk in exceedance of regulatory guidelines for any groundwater use scenario, including a car wash. Four wells are located within the B-I #1 area (L2-02, L2-03, L2-04, and L205). However, no risk exceedances were attributed to these four wells (see Figure 2-2 of the FS). Review of the data provided for these wells (Appendix 4B-1 of the MSGRP Remedial Investigation (RI) Report; USEPA, 2005d) indicate that for the constituents identified as risk drivers for this scenario (1,2-dichloroethane, benzene, trichloroethylene, and naphthalene), all four wells were non-detect for benzene, and the other constituents were not analyzed. [Note, there are additional data presented in the RI Report appendix for locations L2-03 and L2-05 that were not used in the risk assessment. The data were non-detect for all four risk-drivers.] Therefore, no risks or hazards would be identified for a car wash worker in the only two plausible use areas based on zoning.

There are also the following specific issues with the car wash/shower model:

- **The exposure duration used for the car wash worker (25 years) is likely too high, based on USEPA occupational tenure estimates. A more reasonable value is 9 years, which is based on the median occupational tenure for all workers aged 35-39 years (USEPA, 1997b)**
- **Under the USEPA exposure scenario, the car wash worker is exposed to the modeled air concentration for 8 hours/day. However, this is likely an overestimate of the amount of time that the worker is exposed to the modeled air concentration, since it is likely that the worker does not stand in the direct spray area. A value of 4 hours is more reasonable, as it is unlikely that cars are transiting the car wash on a constant basis.**
- **The air modeling using the "shower model" was done with model inputs for a residential bathroom, which are not appropriate for a car wash. This flaw resulted in inhalation risks that are too high as well as PRGs for groundwater that are too low.**
- **The MSGRP HHRA used a "shower volume" of 6 m^3 in its calculation for the car wash scenario. A more realistic estimate of the volume of a car wash is 1000 m^3, based on an estimated car wash size of 90 x 20 x 15 feet = 27,000 ft^3 or 1000 m^3.**
- **Per the following website:**

  http://seattletimes.nwsource.com/html/makeitcount/2002410023_ecoconsumer31.html, it should be assumed that 45 gallons of water is used per car, and that the car wash trip takes one minute. The estimate of 45 gallons is the upper-bound for an automatic car wash. A duration of a 1 minute car wash is assumed. This equates to a water flow rate of 170 L/min.
- **Commercially available automatic car wash driers can be found on the following website: http://www.sonnysdirect.com/system_models_detail_660.html. The apparatus shown has 4 blowers working at 4000 ft^3 per minute (conservatively assuming 10 HP motors). Assuming this occurs within the 27,000 ft^3 car wash, the air exchange rate in the car wash would be 0.6 min^{-1} (4 x 4000 ft^3/min ÷ 27,000 ft^3).**

The effect of applying these more realistic exposure parameters to the car wash "shower model" is to decrease the predicted air concentrations up to two orders of magnitude.

Conclusion - The use of groundwater in a car wash scenario should not have been included in the risk assessment as a complete exposure pathway based on City of Woburn zoning and groundwater use restrictions. However, even if it was included, it should only have been applied to the B-I zoning areas, and only using data from wells located in these areas, not using the summarized data for the Site and study area as a whole. If this had been done, risks for this receptor would be zero in the B-I #1 area (as no constituents were detected) and would not have exceeded the regulatory guidelines in the B-I #2 area. Moreover, if the shower model had been correctly applied to the data, whether in the B-I areas or erroneously for site-wide groundwater, it is likely that no regulatory guidelines would have been exceeded.

1.4.2 Future Industrial Worker Groundwater Exposure Scenario

The hypothetical future industrial worker is assumed to contact groundwater used as industrial process water in an open system via ingestion, dermal, and inhalation exposure pathways. First, as indicated above, it is not reasonable to assume that groundwater would be used in this manner in the future, therefore, these pathways should not be identified as complete in the risk assessment.

Although an industrial groundwater use scenario should not be included in the MSGRP HHRA, there are specific issues with the scenario as constructed by USEPA that need to be discussed. It is assumed that the industrial worker would ingest the process water at a rate of 50 ml per day (slightly less than a quarter cup of water per day). This is the same high intensity water ingestion rate that is assumed for a swimming scenario, where someone is completely submerged in water. This assumption is not reasonable, and is not consistent with USEPA's assumption concerning water ingestion for the recreational teenager in the MSGRP HHRA. For that scenario, USEPA assumed that ingestion of surface water while wading was an incomplete exposure pathway, stating "Ingestion of surface water is not quantitatively evaluated for wading since it is unlikely that teenagers would ingest more than a negligible amount of surface water" (USEPA, 2005a). It is also a reasonable expectation that industrial workers would not ingest more than a negligible amount of process water during the course of a work day, especially considering the health and safety training a worker would receive on the job. Moreover, in its dermal pathway evaluation for this receptor, USEPA assumed dermal contact with process water for one hour each day, and it is presumably during this hour that the water ingestion would occur. If USEPA is assuming contact with water only one hour during the day, then water ingestion would only occur during that hour, which means that this 1/4 cup of water would be ingested in that short time rather than in tiny incidental sips throughout the day. This is not a reasonable expectation. Therefore, under a hypothetical future industrial worker scenario, the water ingestion pathway should be identified as incomplete.

Conclusion - As the future use of groundwater as industrial process water should be identified as an incomplete pathway, no risks or hazards would be calculated for this scenario. If the scenario is unreasonably included in the MSGRP HHRA, the water ingestion pathway should be designated as incomplete.

1.4.3 Future Construction Worker Groundwater Exposure

USEPA also assumed that the construction worker would ingest shallow groundwater encountered in an excavation trench at a rate of 50 ml per day (slightly less than a quarter cup of water per day). Again, this is the same high intensity water ingestion rate that is assumed for a swimming scenario, where someone is completely submerged in water. This assumption is not reasonable, and is not consistent with USEPA's assumption concerning water ingestion for the recreational teenager in the MSGRP HHRA. For that scenario, USEPA assumed that ingestion of surface water while wading was an incomplete exposure pathway, stating "Ingestion of surface water is not quantitatively evaluated for wading since it is unlikely that teenagers would ingest more than a negligible amount of surface water" (USEPA, 2005a). It is also a reasonable expectation that construction workers would not ingest more than a negligible amount of process water during the course of a work day, especially considering the health and safety training a worker would receive on the job. Moreover, in its dermal pathway evaluation for this receptor, USEPA assumed dermal contact with water in an excavation for one hour each and every construction day, and it is presumably during this hour that the water ingestion would occur. Therefore, under a future construction worker scenario, the water ingestion pathway should be identified as incomplete.

Conclusion - As ingestion of shallow groundwater during excavation activities should not be identified as a complete exposure pathway, no risks or hazards would be calculated for this pathway. Dermal contact with groundwater during excavation did not result in risks above regulatory guidelines.

1.5 Soil Exposure Scenarios

1.5.1 Arsenic Bioavailability

The critical soil exposure scenarios that have served as the basis for the FS and the Proposed Plan recommendations for the study area (USEPA, 2005a) are the construction worker and the day care child scenarios. Arsenic is the major risk driver for both of these scenarios. Arsenic is also a major risk driver for the sediment exposure scenarios assumed for the reaches of the Aberjona River south of Route 128. To address one aspect of the uncertainty in those risk estimates, USEPA conducted an in vivo study to develop a relative bioavailability (RBA) for arsenic in sediments in this area (provided as Appendix 6K of USEPA, 2005a). The RBA chosen for use was the highest, i.e., most conservative, of the mean values calculated from the study results (51%). This RBA appropriately was also used to evaluate potential exposure to sediments in the study area.

As arsenic in soils is also an important risk-driver in the study area north of Route 128, USEPA should have conducted a bioavailability study of the soils in this area. In the absence of a bioavailability study for soils, USEPA should also have applied the RBA estimate to arsenic in soils in the study area as well as well as applying it to sediments. Although there may be some differences in soil chemistry between the two areas, the soils upon which USEPA has focused are the former Lake Mishawum bed sediments, and so reasonably could be expected to behave similarly. And as USEPA has used the highest, most conservative RBA, it would be much less likely that potential exposures would be underestimated using this value.

Conclusion - Use of the RBA for soils would result in an almost 2-fold decrease in risks calculated for ingestion of arsenic in soils pathway – ingestion of arsenic in soils is the risk-driver for both the construction worker and day care child scenarios.

1.5.2 Future Construction Worker Soil Exposure Scenario

The USEPA has used overly conservative exposure assumptions to evaluate the construction worker soil ingestion exposure pathway. While the soil ingestion rate used in the MSGRP HHRA, 200 mg/day, is lower than some agency default values, it is still not a realistic estimate. The MADEP recognizes the uncertainty and variability in soil ingestion estimates and states, "Rather than use a combination of assumptions and measured data that imply a high degree of scientific validity, DEP has chosen the simple, and transparent, assumption that an enhanced incidental soil ingestion rate [for a construction worker] is equal to approximately that of a child playing outdoors, 100 mg/day" (MADEP, 2002a).

It should be noted that additional support for a 100 mg/day rather than a 200 mg/day soil ingestion rate comes from a paper by Kissel and coworkers (Kissel et al., 1998) that presents the results of a study of the transfer of soil from hand to mouth by intentional licking. Incidental soil ingestion is assumed to occur due to the transfer of soil in hand to mouth events. Soil was loaded onto the skin by pressing the hand onto soil, and the amount transferred to the mouth was measured. The thumb sucking, finger mouthing, and palm licking activities resulted in geometric mean soil mass transfers of 7.4 to 16 mg per event. The author concludes that "transfer of 10 mg or more of soil from a hand to the oral cavity in one event is possible, but requires moderate soil loading and more than incidental hand-to-mouth contact." However, "the fraction of soil transferred from hand to mouth that is subsequently swallowed is unknown but may be less than 100 percent." In addition, "the adult volunteers in this study reported that the presence of roughly 10 mg of soil in the mouth is readily detected (and unpleasant). Repeated unintentional ingestion of that mass of soil by adults therefore seems unlikely," especially when 10 such events would be required to achieve a 100 mg/day soil ingestion rate.

In addition to the soil ingestion rate issue, USEPA has calculated risks and hazards for the construction worker for surface soil and subsurface soil separately. As excavation involves exposure to both soil horizons, the exposure point concentrations (EPCs) for this scenario should have been calculated using the combined surface soil and subsurface soil data sets, not evaluated as two separate data sets.

Conclusion - Use of the more realistic, yet upper-bound, soil ingestion rate of 100 mg/day for the construction worker would result in a 2-fold reduction in risk and hazard estimates for this pathway. Coupled with the use of the arsenic bioavailability factor for soil ingestion (resulting in an additional 2-fold reduction in ingestion risk and hazard estimates), and elimination of the shallow groundwater ingestion pathway, the resulting potentially carcinogenic risks would not exceed the regulatory guidelines for the construction worker, and the hazard index would be only slightly above the regulatory guideline of 1 for the SO (former Mishawum Lake and associated wetlands) subsurface soil exposure area, and would be below the regulatory guideline for the SO surface soil exposure area.

The ENSR-derived exposure parameters have been used to calculate PRGs for the construction worker scenario, and have been compared to the PRGs calculated by USEPA in the FS. The table below compares the PRGs, calculated with and without the use of the bioavailability factor, and the input exposure assumptions. As can be seen, use of more realistic yet still conservative exposure factors results in PRGs for arsenic in soil for the construction worker scenario that are higher than the USEPA-derived values. The 1000 mg/kg PRG for arsenic should be used, following the methods provided under the section "Application of the PRGs" below, to identify areas where there may be exceedances.

		PRG (mg/kg) for Construction Worker Scenario					
		USEPA Exposure Factors			**ENSR Exposure Factors**		
Compound		**Based on Risk of 1×10^{-4}**	**Based on HI = 1**	**Selected (a)**	**Based on Risk of 1×10^{-4}**	**Based on HI = 1**	**Selected (a)**
Arsenic	Unadjusted	4.34E+03	2.79E+02	**279**	7.96E+03	5.12E+02	**512**
Arsenic	Bioavailable	8.45E+03	5.49E+02	**549**	1.55E+04	1.01E+03	**1007**

Notes:

(a) Lower of PRGs calculated based on cancer and noncancer effects.

Construction Worker Scenario	**USEPA Exposure Factors**	**ENSR Exposure Factors**
Soil Ingestion Rate (mg soil/day)	200	100
Soil on Skin (mg/cm2)	0.20	0.20
Skin Exposed (cm2)	3300	3300
Body Weight (kg)	70	70
Exposure Frequency (days)	125	125
Exposure Duration (years)	1	1
Averaging Time (cancer) (days)	25550	25550
Averaging Time (noncancer) (years)	1	1

1.5.3 Day Care Child Soil Exposure Scenario

Although the study area is zoned B-I (Business Industrial), I-P (Industrial Park), I-P2 (Industrial Park) and OS (Open Space), day care centers are prohibited only within the Open Space areas. However, an

Activity and Use Limitation (AUL) has been established under the Massachusetts Contingency Plan (MCP) program for the property at 10 Commerce Way, permitting day care "inside the building" where the use does not result in direct exposure to subsurface soils. For the remainder of the properties, use as a day care center is allowed. The day care center that was operating within the study area has since closed (note that the MSGRP HHRA did not result in an exceedance of regulatory guidelines for the current day care child scenario based on soil data in the vicinity of the now-closed center).

Many of the exposure parameters used to evaluate the current and future day care child scenario are overly conservative, resulting in unrealistically high exposure and risk estimates for this receptor. The various exposure parameters are discussed below.

Exposure Duration - USEPA used an exposure duration of 6 years for the day care child, which is greater than a possible maximum value. Calls to the public school systems in the towns surrounding the study area (Woburn, Wakefield, Burlington, Wilmington, Reading, Winchester, Lexington, and Stoneham) indicated that children begin a full-day Kindergarten program at age 5. Pre-Kindergarten is also available for children at age 4. Therefore, a typical child may be in day care from infancy until age 5 or potentially only until age 4. Since not all children will go to Pre-Kindergarten, it is conservative to assume that a child may attend day care be between ages 0 and 5. However, children from 0 to 1 year will not be playing outdoors, therefore, a realistic upper-bound estimate of exposure duration for soil ingestion for a day care child is 4 years. Note, this does not take into account children entering pre-Kindergarten, and assumes that children will remain in a single day care center until they reach school age.

Body Weight - While the exposure duration should be changed to 4 years to encompass a 1 to 5 year old child that may be exposed to constituents in soil, rather than the 6 years for the 0 to 6 year old child used by USEPA, the average body weights for the two receptor populations stays the same at 15 kg, based on information in USEPA (1997b).

Exposure Frequency - USEPA used an exposure frequency for the day care child of 150 days per year that is also overly conservative. MADEP's default exposure frequency for a residential child's (0 to 6 years old) exposure to outdoor soil is 150 days/year, which equals 5 days/week from April to October (MADEP, 1995) when the soil is typically available for contact (i.e., ground is not frozen or covered by snow).

MADEP (2002b) states that the exposure frequency for a day care child is believed to be lower than that of a residential child, as day care children's activities do not represent high-end soil contact which would be experienced by the residential child, because day care children's activities include both inside and outside play. Therefore, the exposure frequency of 150 days/year would likely be an over-estimate of the exposure frequency for a day care child. One aspect controlling exposure to soil is the meteorological conditions in the area, as described below.

A meteorological factor is generally used to account for the fraction of the year during which exposure to constituents at the ground surface may occur (Sheehan et al., 1991; USEPA, 1989). It is reasonable to assume that direct contact with soil or soils or intrusive activities will not occur for day care children during inclement weather, i.e., when it is raining or snowing, when the ground is wet or frozen, or when snow or ice (32 degrees F) are covering the ground. Thus the frequency of contact with soils is adjusted for these location-specific meteorological conditions (USEPA, 1989).

There are only a few metrics that can be used to describe the fraction of the year when meteorological conditions are likely to limit exposure. These include temperature and the amount of precipitation per day and per year, which includes rain, snow, and ice. The National Climatic Data Center (NCDC) provides daily temperature and precipitation data (NCDC, 2004). It is assumed that exposure to soils is limited on days when the maximum temperature is less than 32 degrees F. The number of days with precipitation greater than 0.1 inches is selected as the best representation of when exposure is likely to be limited by snow, rain, or ice. The choice of a precipitation target of 0.1 inches is in keeping with guidance provided in the "Compilation of Air Pollution Emission Factors", which assumes that soil suspension will not occur on days with more than 0.01 inches of precipitation (USEPA, 1995c). It is probable, however, that this metric both over- and under-estimates the potential exposure in some conditions. For, example, it is possible that some exposure to soils may occur on days when it rains just over 0.1 inches in the early morning and then the ground dries during the course of the day. Alternatively, significant rainfall, such as greater than 1 inch, is likely to saturate the ground for consecutive days, and several inches of snow (which may fall all on one day with one storm) may cover the ground and inhibit direct contact for several days. With both of these considerations in mind, it is likely that a meteorological factor based on inclement days defined as precipitation greater than 0.1 inches and maximum temperatures less than 32 degrees F is reasonable. The use of the meteorological factor does not imply that no soil exposure occurs on these days, only that exposure during those periods is negligible.

Based on ten years of meteorological data (1994-2003) for Boston, Massachusetts, National Weather Service (NWS) station at Logan International Airport, a site-specific meteorological factor was derived (NCDC, 2004). This station provides the best data capture in the area for both hourly temperature and hourly precipitation data. The difference in weather conditions from Boston to Woburn is not expected to be significant. On the average, 72.8 days/year in this area receive 0.1 or greater inches of precipitation, and there are typically 23.7 days/year with a maximum temperature of 32 degrees F or below (i.e., the temperature never rises above freezing during the day) (NCDC, 2004). Accounting for days when both events occur (2.6 days), the number of inclement days, 93.9, can be calculated (72.8 + 23.7 – 2.6 = 93.9). It is assumed that these days are evenly spaced throughout the course of the year. The meteorological factor is then calculated (93.9/365 = 25.7%). Thus it is assumed that exposure to soils will not occur for the day care child 25.7% of the assumed days of exposure (exposure frequency) due to weather restrictions. Applying this factor to the MADEP residential exposure frequency of 150 days per year results in an exposure frequency of 111.4 days/year or approximately 115 days/year for the day care child (where it is assumed that rain events between April and October limit soil contact).

Soil Ingestion Rate - The soil ingestion rate used in the MSGRP HHRA for the day care child is 200 mg/day, which is the default value for a residential child used by USEPA. This is an upper bound number that is not justified for the scenario. The MADEP's residential child soil ingestion rate is 100 mg/day (MADEP, 1995). As noted above, MADEP (2002b) states day care children's activities do not represent high-end soil contact which would be experienced by the residential child, because day care children's activities include both inside and outside play. Thus it would be reasonable to assume that the day care child's soil ingestion rate would be even lower than 100 mg/day, however, it certainly represents a conservative upper bound for this receptor. This is also the average soil ingestion rate for residential children provided in USEPA's Exposure Factors Handbook (USEPA, 1997b). The soil ingestion rate of 100 mg/day should be used in the MSGRP HHRA for the day care child.

Surface Area and Soil Adherence Factor - A body surface area and soil adherence factor were recalculated for a day care child, assuming a 1 to 5 year old day care child can go outdoors and potentially contact soils. Using information provided in USEPA's Exposure Factors Handbook (USEPA, 1997b), as shown in the following table, a surface area of 2040 cm^2 was calculated based on the average (50th percentile) surface area for males and females, including hands, forearms, lower legs, and feet. A soil adherence factor of 0.04 mg/cm^2 was calculated based on this revised surface area. The surface area of 2040 cm^2 and the soil adherence factor of 0.04 mg/cm^2 should be used in the MSGRP HHRA for the day care child.

	Day Care Child (1 to 5 years old)		
Exposed Body Part	**Surface Area 50th percentile (a) (cm^2)**	**Soil Loading Day Care Kids (mg/cm^2) (b)**	**Total Soil Mass (mg)**
Hands	364	0.0923	33.56
Forearms	425	0.0230	9.78
Lower legs	806	0.0195	15.72
Feet	445	0.0646	28.75
Total	2,040	--	87.80
Area-Weighted Soil Adherence factor (mg/cm2) = Soil mass/Surface area =			0.04

Note (a) - Data from USEPA (1997b). Based on average of boys (Table 6-6) and girls (Table 6-7) total body surface area (6,557 cm2), and mean percentages of total surface area for individual body parts (Table 6-8). Represents average 50th percentile surface area for males and females of hands, forearms, lower legs, and feet).

Note (b) - Data from USEPA (1997b). Table 6-12. Day care kids Nos. #1a, #1b ,#2c, #3.

Exposure Point Concentrations - Exposure point concentrations used in the MSGRP HHRA for the day care child soil exposure pathways are the 95% upper confidence limit (UCL) on the arithmetic mean. Implicit in this assumption is that soils with the highest constituent concentrations are exposed in areas in which day care children may be playing. In USEPA's guidance on lead (USEPA, 2001a, 2003a), standards are provided to be protective of children in residential areas. A value of 400 mg/kg is used for specific "play areas," while a value of 1,200 mg/kg is used to evaluate other areas of "bare soil" in residential yards. USEPA is acknowledging a distinction here between exposure areas, even within a residential yard. Assuming that the 95% UCL concentration will occur precisely within a child's play area is unrealistic. It is even more unrealistic to assume that all of the subsurface soil in the study are could one day be brought to the surface and be available for contact. It should be noted that the majority of the property in the study area has already been developed, i.e., subjected to construction and the reworking of soils, and it is still the subsurface soils that have the higher concentrations (EPC = 92 mg/kg in surface soils and 1900 mg/kg in subsurface soils). However, if the assumption of soil redistribution were correct, one would expect little or no difference in surface and subsurface soil concentrations in the study area as a result of the development. This assumption of subsurface to surface soil redistribution resulted in highly exaggerated risk estimates for the day care child.

Conclusion - For the future day care child assumed to be exposed to surface soils in the SO area, arsenic in soils is the risk driver, and application of the more realistic and reasonable exposure parameters described above would result in a hazard index that is below regulatory guidelines (the potential carcinogenic risk level is already below regulatory guidelines, but there would also be a decrease). Both would decrease with the application of the bioavailability factor.

Similarly, for the future day care child assumed to be exposed to subsurface soils in the SO area, application of both the more realistic and reasonable exposure parameters described above and the bioavailability factor would result in reductions in the hazard index and potential carcinogenic risk estimates, however, both would likely be above regulatory guidelines. However, the risk assessment results do not represent the extent to which the day care child exposure to subsurface soils scenario is unlikely to occur.

The ENSR-derived exposure parameters have been used to calculate PRGs for the day care child scenario, and have been compared to the PRGs calculated by USEPA in the FS. The table below compares the PRGs, calculated with and without the use of the bioavailability factor, and the input exposure assumptions. As can be seen, use of more realistic, yet still conservative exposure factors results in PRGs for arsenic in soil for the day care child scenario that are higher than the USEPA-derived values. The 274 mg/kg PRG for arsenic should be used, following the methods provided under the section "Application of the PRGs" below, to identify areas where there may be exceedances.

Compound		PRG (mg/kg) for Day Care Child Scenario					
		USEPA Exposure Factors			ENSR Exposure Factors		
		Based on Risk of $1x10^{-4}$	Based on HI = 1	Selected (a)	Based on Risk of $1x10^{-4}$	Based on HI = 1	Selected (a)
Arsenic	Unadjusted	1.31E+02	5.05E+01	51	5.42E+02	1.39E+02	139
Arsenic	Bioavailable	2.55E+02	9.93E+01	99	1.06E+03	2.74E+02	274

Notes:
(a) Lower of PRGs calculated based on cancer and noncancer effects.

Day Care Child Scenario	USEPA Exposure Factors	ENSR Exposure Factors
Soil Ingestion Rate (mg soil/day)	200	100
Soil on Skin (mg/cm2)	0.20	0.04
Skin Exposed (cm2)	2800	2040
Body Weight (kg)	15	15
Exposure Frequency(days)	150	115
Exposure Duration (years)	6	4
Averaging Time (cancer) (days)	25550	25550
Averaging Time (noncancer) (years)	6	4

1.6 Sediment Exposure Scenarios

1.6.1 Future Dredger Sediment Exposure Scenario

The future dredger scenario is the risk driver for the sediments in the HBHA. For the same reasons as discussed above for the future construction worker receptor, the soil/sediment ingestion rate for the dredger should be 100 mg/day in the MSGRP HHRA. This is a reasonable and yet still upper-bound estimate. It is unreasonable to assume that dredging activities would occur over a 2-year period. As with the construction worker, the exposure duration should be only 1 year in the MSGRP HHRA, which is both realistic and reasonable. The exposure frequency for this receptor in the MSGRP HHRA should also be the same as that for the future construction worker, 125 days per year, equivalent to 5 days per week for 25 weeks.

The EPCs used for this scenario are unreasonable, unrealistic, and do not reflect the scenario being evaluated. EPCs have been derived separately for each of the four sediment core locations in the HBHA. The arsenic concentrations, which are the risk drivers for this scenario, are highly variable, and with only 4 sample results for each location, the maximum detected concentration was used as the EPC. For example, at SC01, the arsenic concentrations are 150, mg/kg, 23 mg/kg, not detected and not detected. Using USEPA's methodology, the EPC for this location is 150 mg/kg. USEPA acknowledges this problem in the uncertainty section of the text, but that is not enough. Having been alerted to this problem, it should have been addressed appropriately. The maximum detected concentration was used as the EPC at all four locations. This use of the data, in conjunction with USEPA's exposure assumptions, assumes that the dredger works at a single location for a 2-year period and ingests the maximum detected concentration of arsenic at each location at a very high sediment ingestion rate. This is not at all realistic. There is a wealth of sediment information from the HBHA, and it is unrealistic to assume that dredging operations would occur only in these four locations. USEPA should carefully review the sediment data and use all of the data from locations that would cover hypothetical future dredging operations. It is unclear whether dredging operations would be incompatible with the remedies considered in the Proposed Plan (USEPA, 2005c).

Conclusion - It is likely that if the more realistic exposure assumptions and EPCs are used in the MSGRP HHRA, risks for this hypothetical future dredger receptor would not exceed regulatory guidelines.

1.7 Arsenic Toxicity

USEPA recognized some of the uncertainties in the cancer potency estimate for arsenic in the uncertainty section, but did not then review the risk assessment results and determine whether the uncertainties in the potency estimate could be addressed quantitatively, or whether more realistic values for other parameters could be used to off-set this uncertainty (see the discussion of tiered approaches above). Moreover, the predicted noncancer hazard for arsenic is the primary driver for many of the regulatory guideline exceedances. Therefore, the bases of both the cancer and noncancer toxicity values for arsenic are reviewed below.

1.7.1 Noncancer Reference Dose

To evaluate the chronic health effects of arsenic, two reports of an epidemiology study of Taiwanese populations consuming arsenic in drinking water and other sources (Tseng et al., 1968; Tseng, 1977) have been used by USEPA's Office of Research and Development (ORD) to derive the chronic reference dose (RfD) for arsenic that is included in USEPA's Integrated Risk Information System (IRIS) database (USEPA, 2005e). The RfD was verified in 1990 and was last revised in 1993 (USEPA, 2005e).

USEPA identified a No Observed Adverse Effects Level (NOAEL) of 0.0008 mg/kg-day from the Tseng studies based on the observation of hyperpigmentation, keratosis and possible vascular problems in the study population. An uncertainty factor of 3 was applied to account for lack of information on whether reproductive toxicity is a critical effect, and to account for some uncertainty as to whether the NOAEL accounts for all sensitive individuals. The resulting RfD is 0.0003 mg/kg-day.

This analysis does not reflect the results of a recently published comprehensive epidemiological study indicating that malnutrition enhances susceptibility to arsenic-related health effects (Mitra et al., 2004). Moreover, the underlying analyses presented in IRIS do not reflect the substantial number of studies that have been conducted since the RfD was last revised and that call into question the validity of the exposure estimates in the Tseng study population (e.g., Brown and Chen, 1995) or provide additional information regarding the noncancer health effects of arsenic in other populations (e.g., Guha Mazumder et al., 1998).

As noted above, a number of scientists have questioned the validity of the exposure characterization in the Tseng study population. For example, Brown and Chen (1995) noted that arsenic concentrations in drinking water in 40% of the villages in the Tseng study were characterized by a single well sample and, in others, use of both shallow and deep artesian wells led to arsenic concentration data in groundwater with very high coefficients of variation. In a modeling exercise, they found that eliminating data from the seven villages with the most suspect groundwater well data led to a very different dose-response curve. Specifically, these analyses suggested that disease incidence increased above background levels only when arsenic concentrations in groundwater were greater than 0.1 mg/L.

To determine a lowest observed adverse effect level (LOAEL), the average arsenic concentration in well water for the designated low exposure group (i.e., wells with concentrations between 0 and 0.30 mg/L) was identified by USEPA. The low exposure group wells include four surface wells with reportedly very low arsenic concentrations. Averaging the arsenic concentrations in the low exposure wells resulted in an arsenic concentration for these wells of 0.17 mg/L. Because this average includes data from wells where the arsenic concentration is essentially zero, this value provides a conservative estimate of the LOAEL concentration (i.e., the effects observed in the low dose group are most likely due to wells with arsenic concentrations at the upper end of the range). This conservative bias is unavoidable, however, because of the way the exposure data were categorized in the Tseng reports.

Based on the control group described in Tseng (1968) USEPA identified a NOAEL of 0.009 mg/L, stating that the control group "shows no evidence of skin lesions and presumably blackfoot disease, although this latter point is not explicitly stated." However, as noted in Tseng (1977) "none of the residents of the endemic area who had consumed only surface water or water from shallow wells developed blackfoot disease. This appears to be because the shallow well water is almost free from arsenic (0.001-0.017

ppm)." The arithmetic mean concentration of 0.009 mg/L of the range of arsenic concentrations in these wells was identified as the NOAEL.

This approach is problematic for two reasons. First, the accuracy of this concentration range is questionable. For example, Tseng et al. (1968) noted that "The shallow wells were usually free from arsenic (0.001 ppm), though some had a considerably higher concentration (1.097 ppm). Second, the NOAEL represents the lower bound of the effects threshold. Including individuals with drinking water concentrations as low as 0.001 ppm in the NOAEL population is the equivalent of including untreated control animals in the low dose group in a toxicology study. While such an approach does identify a concentration without likely adverse effects, it is an extremely conservative estimate of that concentration.

Because of these limitations, the observed NOAEL reflected in the Tseng data should not be used as the sole basis for quantifying potential toxicity associated with long-term exposures. Instead, to better reflect available information, the conservative observed NOAEL should be used in conjunction with the LOAEL. For example, the LOAEL from the 1977 Tseng report (0.170 mg/L) can be divided by a factor of 10 to derive a predicted NOAEL value of 0.017 mg/L. Because individuals in the shallow well group were exposed to arsenic in drinking water at concentrations up to this value without evidencing any symptoms of blackfoot disease, a concentration of 0.017 mg/L can be viewed as a reasonable prediction of the NOAEL. This concentration is equivalent to 0.0015 mg/kg-day, assuming consumption of 4.5 liters of water per day and a 55 kg bodyweight, the standard factors used by USEPA in adjusting concentration values based on the Taiwanese studies.

In its calculations, USEPA also adjusts the observed LOAEL and NOAEL derived from the Tseng et al. (1968) study to account for the amount of inorganic arsenic ingested as food. USEPA estimates that the arsenic intake from consumption of sweet potatoes and rice was 0.002 mg/day (or 0.00004 mg/kg-day assuming a 55 kg bodyweight). Based on currently available data, this estimate appears to be too low. Yams and rice in the Blackfoot disease endemic regions in Taiwan have been reported to be particularly high in inorganic arsenic (Yost et al., 1994).

USEPA has previously used a value of 0.05 mg/day (0.0009 mg/kg-day) for the Taiwanese dietary intake of arsenic. A diet-adjusted predicted NOAEL of 0.0024 mg/kg-day would be obtained by combining the 0.05 mg/day dietary arsenic intake rate with the predicted NOAEL estimate of 0.0015 mg/kg-day described above.

It should also be noted that, since the IRIS RfD was last revised in 1993, several other epidemiology studies of arsenic non-cancer health effects have been published (as discussed in NRC, 1999, 2001), including one by Guha Mazumder and coworkers (1998). The Guha Mazumder study provides additional support for the higher NOAEL value (identified above) that can be derived from the Tseng reports. Guha

Mazumder et al. studied a population in West Bengal, India, which was also exposed to arsenic via drinking water. The exposure durations in this study ranged from years to decades. This study presents two advantages relative to the study by Tseng et al. First, a large number of children were included in the study population, i.e., approximately 8 percent of the studied population was under the age of 10 years old. Second, the population generally had poor nutritional health. Thus, the data from this study provide some indication of the possible health consequences for a sensitive population.

In addition, unlike the blackfoot disease studied by Tseng (which has been reported to be associated with other exposures, e.g., Lu, 1990), Guha Mazumder studied both keratosis and hyperpigmentation. These latter two effects may be earlier endpoints in arsenic toxicity. In the Guha Mazumder et al. study, the prevalence of both keratosis and hyperpigmentation was extremely low in the lowest dose group (< 50 mg/L). Thus, 0.050 mg/L can be considered a minimal effect LOAEL. Assuming 4.5 L/day of water consumption and a 55 kg body weight (similar to the population in Taiwan), the estimated daily arsenic dose is 0.004 mg/kg-day. Dividing by a factor of 3 for the minimal effect LOAEL-to-NOAEL extrapolation results in a NOAEL of 0.0014 mg/kg-day, a value that is similar to what was derived above using the LOAEL from the Tseng reports. As noted above, the Guha Mazumder et al. study population included a large number of children and likely included a large number of malnourished individuals. Additional evidence of the malnourishment of this population and the resulting enhanced susceptibility to arsenic-related health effects is provided in a recently published case-control epidemiological study of more than 500 individuals from West Bengal which broke new ground in examining the impact of dietary nutrient intake levels on arsenic-related health effects (Mitra et al., 2004). These observations suggest that additional uncertainty factors are not required.

Moreover, it should be noted that epidemiological studies of U.S. populations consuming drinking water containing arsenic concentrations equal to or greater than 0.050 mg/L have not indicated adverse health effects such as those reported in the Tseng studies. For example, Valentine et al. (1992) surveyed four U.S. communities with arsenic concentrations in drinking water that were equal to or greater than 0.100 mg/L. Based on comparisons of the study group, with a control population with arsenic concentrations in drinking water that were less than 0.001 mg/L, the researchers reported "No difference in health status for gastrointestinal, neurological, musculoskeletal, circulatory and skin disorders was found." The difference in sensitivity seen between the populations studied by Tseng and Guha Mazumder and those in the U.S. may result from the differences in nutritional status of these groups or genetic differences in responses to arsenic (Buchet and Lison, 2000). This comparison again demonstrates the conservativeness of using the Tseng data to characterize potential health risks associated with arsenic for a U.S. population.

Conclusion - Based on this review of the available scientific data (including numerous studies that have been published since the RfD was last revised), use of a diet-adjusted NOAEL of 0.0024 mg/kg-day (reflecting a NOAEL of 0.0015 mg/kg-day and a dietary intake of 0.0009 mg/kg-day) together with an MOE of 1 represents a conservative (i.e., health-protective) toxicity benchmark (RfD = 0.0024 mg/kg-day) for assessing potential non-cancer health risks associated with long-term exposures. This RfD is 8-fold higher that that developed by USEPA. Use of this value would result in an 8-fold decrease in the calculated hazards in the MSGRP and would result in an 8-fold increase in the noncancer-based PRGs.

1.7.2 Cancer Potency Estimates

Detailed comments on the cancer potency estimate for arsenic were submitted to USEPA as part of Gradient Corporation's comments on the "Baseline Human Health Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA, USEPA Region 1, March, 2003." These comments are included here by reference. An overview of the comments and their applicability to the MSGRP HHRA are provided below.

USEPA has developed an oral cancer potency estimate for arsenic, which is available on IRIS (USEPA, 2005e). The cancer potency estimate suffers from many of the same issues as discussed above for the noncancer RfD.

Epidemiological studies conducted in the U.S. have consistently shown a lack of association between arsenic exposure and cancer outcomes. Studies looking at bladder and lung cancer in a population in Utah, skin cancer in a population in Oregon, childhood cancers in Nevada, childhood cancers in the vicinity of the ASARCO Ruston copper smelter, and bladder cancer mortality in 133 U.S. counties all failed to show any significant association between the outcomes and exposure to arsenic. It should also be noted that the exposure levels evaluated in the U.S. populations are substantially lower than those of the Taiwanese population upon which the arsenic cancer potency is based. Therefore, the arsenic cancer potency estimate developed by USEPA based on the Taiwanese data likely results in an overestimate of arsenic-related cancer risk in the U.S.

In addition, the model that USEPA has used to develop the arsenic cancer potency estimate assumes that the dose-response relationship is linear at low doses. There is substantial mechanistic information to indicate that the arsenic dose-response relationship is not linear at low doses. All of arsenic's plausible mechanisms, including indirect genotoxicity, modulation of DNA methylation patterns and DNA repair, and ability to induce protective cellular mechanisms, are consistent with a nonlinear dose-response. In addition, although several studies conducted on populations outside of the US have shown increased risk of cancer, risks are only increased at relatively high doses of arsenic, indicating support for a nonlinear dose-response.

In the MSGRP HHRA, USEPA has estimated site-related lifetime daily average arsenic intakes up to 0.97 µg/kg-day for a future day care child assumed to be exposed to arsenic in subsurface soil, and up to 0.03

µg/kg-day for an adult construction worker assumed to be exposed to arsenic in subsurface soil. In contrast, estimated arsenic intakes as high as 5.7 µg/kg-day have been experienced by U.S. populations without evidence of increased cancer risks. Specifically, for the Utah study, which is among the largest and best-conducted of the epidemiological studies of US populations with elevated arsenic exposures, average intakes of arsenic in drinking water ranged from 0.26 to 2.7 µg/kg-day (based on average drinking water consumption of 1L/day). Over 1,200 members of the Millard County, Utah, cohort resided in the two communities with the highest intake level (average 2.5 µg/kg-day), many for their entire lifetimes. Despite these elevated intakes, no elevated death rates from bladder or lung cancers were observed for those who died through November 1996 (2,203 cohort members), and death rates were not elevated among the cohort members with the highest levels of drinking water arsenic. The observed bladder and cancer mortality risks in the Utah study are lower than the baseline health risks predicted for the general population of Utah, even with arsenic drinking water concentrations that on average were as high as 0.191 mg/L, and at times exceeded 0.6 mg/L.

In non-U.S. studies, populations were exposed to arsenic in drinking water at concentrations of 0.1 mg/L or greater. In order to calculate arsenic intakes, certain assumptions must be made about the exposed populations. For example, using estimates of water consumption patterns in Taiwanese males developed by the National Research Council (NRC, 1999; NRC, 2001), calculated arsenic intakes at 0.1 mg/L in drinking water are 8.2 µg/kg-day. This assumes an average Taiwanese male weighs 55 kg and drinks 4.5L/day of arsenic-containing water. If one assumes, based on re-analysis of the Taiwan data, that cancer is not increased until levels of 0.4 mg/L, then the estimated carcinogenic intake in Taiwan would be 22 µg/kg-day.

In contrast, site-related exposures are considerably less than the drinking water exposures in these studies. As noted above, the highest lifetime average daily intake calculated in the MSGRP HHRA of 0.3 ug/kg-day for the construction worker exposure to subsurface soil is 27 times lower than doses received at 0.1 mg/L in the Taiwanese studies. Thus, modest intakes of arsenic from exposure to surface or subsurface soil in the MSGRP HHRA study area are unlikely to present a significant toxicological concern.

Moreover, estimated arsenic exposures in the MSGRP HHRA are not significantly different than arsenic exposures permitted in drinking water at the MCL of 0.01 mg/L, which is a level designed to be health protective (USEPA, 2001d). For arsenic in subsurface soil, the future day care child intake is 0.97 ug/kg-day and the future construction worker intake is 0.3 ug/kg-day. By comparison, exposure to arsenic in drinking water at the current MCL of 0.01 mg/L would yield an estimated intake of 0.7 µg/kg-day for a 15 kg child and 0.3 µg/kg-day for a 70 kg adult, based on drinking water intakes of 1L/day for children and 2L/day for adults. Thus, the hypothetical and unlikely exposures to arsenic in subsurface soils at the site are essentially the same as those considered by USEPA to be health protective in drinking water. Note that the calculated site intake rates would be much lower using the recommended exposure parameters discussed in this document.

Conclusion - The uncertainties and high degree of conservatism in the cancer potency estimates provide an additional reason why the MSGRP HHRA should have been refined with more realistic exposure assumptions prior to using it as the basis for remedy decisions.

1.8 Trichloroethylene (TCE) Toxicity

TCE presents an inhalation risk for the car wash worker receptor. The USEPA's 2001 draft TCE reassessment presents not individual cancer potency values (as is the normal practice) but a range of values, with each value based on data from different animal or human studies (USEPA, 2001c). USEPA's PRGs for the MSGRP HHRA were calculated using cancer potency values from the upper ends of these ranges, i.e., 4×10^{-1} (mg/kg-day)$^{-1}$ as the oral slope factor and 1.1×10^{-4} (ug/m^3)$^{-1}$ as the inhalation unit risk. Note that there is no statistical basis for selecting values at the top of the range; they are not "upper bound" values in the traditional sense because each potency value is based on a different dataset and the likelihood of a particular potency value being "right" is independent of the others. This was also noted by the USEPA Science Advisory Board which recommended against treating the range as a statistical distribution (USEPA, 2002b). As noted below, an alternate oral slope factor and inhalation unit risk can be developed from USEPA's 2001 TCE analysis, in a manner consistent with USEPA recommendations.

Using the top value in the cancer potency range is problematic in that such an approach ignores questions about the scientific validity and relevance of the underlying studies. The cancer potency values used for the MSGRP HHRA are based on the ecological study of Cohn et al. (1994), which evaluated cancer risk in Northern New Jersey residents exposed to TCE and other chemicals in drinking water. Problems with this study include the estimation of exposures from community-wide drinking water data collected 10 to 20 years after the exposure period of interest, and the residents' simultaneous exposures to other chlorinated chemicals in drinking water. These are significant limitations in using the Cohn et al. data for risk assessment. As noted by USEPA, "The residents were exposed to other drinking water contaminants, so that attributing all risk to TCE [as was done in the USEPA analysis] can over estimate the risk from TCE." (USEPA, 2001, p. 4-17, comment in brackets added). Based on the potential problems with the Cohn et al. study, the cancer potency values that are derived from it should not be used in the MSGRP HHRA.

Lewandowski and Rhomberg (2005) recently published an analysis of the USEPA TCE cancer potency range in which they evaluated each of the underlying studies with respect to scientific validity and relevance for risk assessment. Based on their analysis, they identified liver tumors and the epidemiological study of Anttila et al. (1995) as the most reliable and scientifically valid basis for assessing TCE carcinogenicity. Reliance on the liver tumor endpoint was also suggested by the USEPA Science Advisory Board (USEPA, 2002b). In the USEPA's TCE cancer potency range, the Anttila et al. liver tumor data is associated with an oral slope factor of $7x10^{-2}$ $(mg/kg\text{-}day)^{-1}$ and an inhalation unit risk of $9x10^{-7}$ $(ug/m^3)^{-1}$. These values are 6-fold and 120-fold lower, respectively, than the values used in the MSGRP HHRA.

Conclusion - Because the Anttila et al. values represent a more scientifically defensible starting point for characterizing TCE's carcinogenic potency, the MSGRP HHRA overstates the risks from ingestion of TCE in groundwater and inhalation of TCE in indoor air, notwithstanding that neither of these exposure pathways should be identified as complete within the study area.

1.9 Benzene Toxicity

USEPA has classified benzene as a known human carcinogen (USEPA, 2005e) based on studies of the incidence of leukemias in workers exposed to benzene (between 2 ppm to over 200 ppm, or 6.5 mg/m^3 to over 650 mg/m^3) in the workplace. As noted by USEPA (2005e):

> **"At present, the true cancer risk from exposure to benzene cannot be ascertained, even though dose-response data are used in the quantitative cancer risk analysis, because of uncertainties in the low-dose exposure scenarios and lack of clear understanding of the mode of action. A range of estimates of risk is recommended, each having equal scientific plausibility."**

The range of inhalation cancer slope factors for benzene is 2.2E-06 $(ug/m3)^{-1}$ to 7.8E-06 $(ug/m3)^{-1}$. The range of oral cancer slope factors for benzene is 1.5E-02 $(mg/kg\text{-}day)^{-1}$ to 5.5E-02 $(mg/kg\text{-}day)^{-1}$. These ranges, not a single point value, should be used in the MSGRP HHRA calculations.

Conclusion - The result of using the most conservative toxicity value for benzene is to overstate the risks from exposure to benzene.

1.10 Site-Specific Preliminary Remediation Goals (PRGs)

1.10.1 Errors in the PRG Equations

It should be noted that the PRG equations provided in Appendix A of the FS (USEPA, 2005b), are incorrect on both the risk assessment and simple arithmetic levels. The use of the RAGS Part D (USEPA, 2001b) format for the MSGRP HHRA does not help with the transparency of the risk assessment process, nor do errors such as these.

For example, for the Industrial Worker PRGs, the PRG equations attempt to combine oral, dermal and inhalation exposures. The overall form of the equation is incorrect. The correct starting equation is:

EQN 1: PRG = Target Risk / [(SForal * ing intake factors) + (SFderm * derm intake factors) + (SFinh * inh intake factors)]

This does NOT equal:

EQN 2: PRG = [Target risk/(SForal * ing intake factors)] + [Target risk/(SFderm * derm intake factors)] + [Target risk/(SFinh * inh intake factors)]

1.10.2 Application of the PRGs

USEPA has used the site-specific PRGs calculated in the FS as screening levels to identify locations that have a PRG exceedance, and thus areas that require additional action. Use of PRGs in this manner exaggerates the areas that may need to be addressed in the FS. The PRGs are EPC surrogates, just as the EPCs take into account the distribution of the data and ideally represent the 95% upper bound on the arithmetic mean concentration, so too should the PRGs. To identify locations to be addressed by the FS, the following steps should be taken:

- *Sample results within an exposure area should be ranked according to concentration.*
- If no results exceed the PRG, no further action is needed.
- If there are PRG exceedances, the location of the maximum detected concentration should be identified and the result removed from the dataset.
- The EPC should be recalculated without this last value, and compared to the PRG.
- If the EPC is less than the PRG, no further calculation is needed and the remedy should address the location of the exceedance.
- If the EPC is greater than the PRG, steps 3 and 4 should be repeated until the EPC is less than or equal to the PRG.
- The remedy should then address the locations that have been eliminated from the EPC calculation using this process.

A similar process should be used when evaluating confirmatory sampling. Data from samples from areas excavated or otherwise sequestered should be removed from the EPC calculations, and the results of confirmatory samples should be added. The remedy can be concluded once the recalculated EPC is less than or equal to the PRG.

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2.0 Comments on Ecological Risk Assessment

Menzie-Cura & Associates, Inc. prepared these comments on the Baseline Ecological Risk Assessment (BERA), Feasibility Study (FS), and Proposed Plan for the Industri-Plex Superfund Site Multiple Source Groundwater Response Plan (MSGRP) Study Area (the Site) in Woburn, Massachusetts. Our comments are based on our review of the portions of the documents that describe work done at or proposed for the Halls Brook Holding Area (HBHA) Pond, the only portion of the site where the US Environmental Protection Agency (USEPA) identified ecological risk.

The comments fall into four main categories:

- **USEPA did not take the limited benthic invertebrate habitat of HBHA Pond into account in their analysis. Even under the best of conditions, HBHA Pond is a stormwater retention basin and not a quality ecological habitat. Remediation to be conducted under USEPA's Proposed Plan will not improve the quality of the benthic invertebrate habitat in HBHA Pond.**
- **USEPA arbitrarily selected a Preliminary Remediation Goal (PRG) for the protection of benthic invertebrates from a limited amount of data. In selecting the PRG of 273 mg/kg for arsenic in HBHA sediments, USEPA ignored data showing no effects on benthic invertebrates at arsenic concentrations over 1,000 mg/kg. They also ignored their own analyses showing that effects on benthic invertebrates were more highly correlated to habitat conditions (dissolved oxygen concentration, acid volatile sulfide concentrations, water depth, and flow) than sediment arsenic concentrations.**
- **National Recommended Water Quality Criteria (NRWQC) for dissolved arsenic were not exceeded in outflow from HBHA Pond under baseflow or storm conditions.**
- **The HBHA Pond in its current condition is currently providing the wetland functions listed in the Massachusetts Wetlands Regulations (310 CMR 10.01(2)) and does not require wetland replication to provide those functions.**

2.1 HBHA Pond Provides Poor Ecological Habitat

USEPA states that the ecological risk they are addressing in HBHA Pond is risk to benthic invertebrates. However, the HBHA Pond was created to serve as a stormwater retention basin, and not ecological habitat. In USEPA's (TTNUS, 2005) Remedial Investigation (RI) report for the site, they state:

> **"The HBHA was constructed as a storm water retention area and control structure as part of an area-wide commercial development project. Based on a review of the limited available information, the design effort was directed towards management of flows during storm conditions and not towards developing a viable wetland habitat."**

HBHA Pond is long (1,100 feet) and narrow (200 feet) with relatively steep sidewalls and maximum and average depths of approximately 25 feet and 9 feet, respectively. The deeper areas occur in the northern and southern portions of the Pond. This design limits the littoral zone, the zone in a pond that provides the highest quality habitat to invertebrates, fish, and wildlife, to a narrow band around the perimeter of the pond.

Because of this design, the HBHA Pond becomes thermally stratified in the summer. In thermally stratified ponds, the hypolimnion, or bottom layer, becomes anoxic in the summer months. These characteristics of a stratified pond have been observed in HBHA Pond.

According to USEPA's technical guidance document on developing bioassessment and biocriteria programs for lakes and reservoirs (USEPA, 2003) and other sources (Moss, 1980), the benthic invertebrate community in the hypolimnion of stratified lakes is usually not abundant or diverse because only a few species of invertebrates are tolerant of low dissolved oxygen concentrations. The main groups of species typically found below the thermocline are chironomid larvae, oligochaete worms, and phantom midge larvae (*Chaoborus*) (Wiederholm, 1980). If anoxia persists in a pond or lake, the invertebrate community in the hypolimnion can be completely absent (USEPA, 2003).

The benthic invertebrate community in the deep sampling stations in HBHA Pond (Stations MC-SED-05 and MC-SED-07) exhibited the characteristics described by USEPA in their guidance document. One organism, a chironomid at MC-SED-05 and *Chaoborus* at MC-SED-07, were observed in each sample. By comparison, the reference pond did not exhibit an abundant or diverse benthic community and had a total of nine organisms in the sample, three of which were *Chaoborus*. This indicates that the depauperate benthic community in the hypolimnion of HBHA Pond is representative of the hypolimnion of seasonally stratified ponds and lakes that exhibit low dissolved oxygen levels.

On another Superfund Site in USEPA Region I with elevated arsenic concentrations in sediment, USEPA has restricted their sediment cleanup alternatives in a kettle pond to sediment above the thermocline. USEPA's (2005) Preferred Alternative for cleanup of Sinking Pond on the W.R. Grace Superfund Site in Acton, Massachusetts, targets sediment above the thermocline for remediation. It is implicit in their Proposed Plan for the W.R. Grace Site, that cleanup of sediments below the thermocline would not improve benthic invertebrate habitat because of the seasonal anoxia in the bottom of the pond. Therefore, USEPA's stated objective for remediation of sediments beneath a thermocline to protect benthic invertebrates in HBHA Pond is inconsistent with their Proposed Plan for a natural water body elsewhere in USEPA Region I.

Under the Proposed Plan for the HBHA Pond, remediation of sediments will occur only in the southern portion of the Pond. Because the bottom waters in the southern portion of the pond are likely to continue to be anoxic in the summer after implementation of the Proposed Plan, the remediation proposed by USEPA for HBHA Pond will not provide better or additional habitat for benthic invertebrates (or fish).

2.2 Selection of the Arsenic PRG for Sediment in HBHA Pond was Arbitrary

USEPA arbitrarily selected the arsenic PRG for sediment from a subset of the existing data from HBHA Pond. They did not use their own analyses reported in the BERA to develop PRGs protective of benthic invertebrates, despite the fact that they performed in-depth analyses of the benthic invertebrate toxicity and community data for the HBHA Pond. Some of the data they ignored were statistical correlations of sediment arsenic concentrations and benthic invertebrate toxicity data. Instead of using these data to develop PRGs, USEPA simplistically selected the lowest arsenic concentration in sediment at which toxicity was measured, ignoring many other sources of information from which to develop a robust PRG. USEPA also ignored their own analyses, which indicated that the greatest correlations were found between benthic community and habitat quality measurements (acid volatile sulfide concentration in the sediment, water depth, dissolved oxygen content of the overlying water, flow regime, and total organic carbon (TOC)). These factors have a greater effect on the benthic invertebrate population in HBHA than contaminant concentrations. In fact, body burdens of arsenic in benthic invertebrates were similar in the deep water stations in HBHA Pond and downstream in the wetlands. This supports the analyses that demonstrate the toxicity to benthic invertebrates in deep water Pond locations is due to causes other than arsenic.

The BERA evaluated four different lines of evidence to assess risk to benthic invertebrates. USEPA performed numerous statistical analyses on the data collected to evaluate these lines of evidence. However, they used only one type of data, the sediment toxicity data, to develop the PRGs. As shown on Table 1, the only evidence of acute or chronic toxicity to benthic invertebrates observed in sediment toxicity tests (except for that which also occurred at reference stations) occurred in the HBHA Pond in samples SD-MC-05, SD-MC-06, and SD-MC-07. USEPA selected the lowest concentration of arsenic in sediment from these three samples as the PRG for the protection of benthic invertebrates. This concentration is 273 mg/kg from SD-MC-06.

In addition to ignoring the other benthic invertebrate analyses conducted at the Site, this PRG also ignores the fact that no effects on benthic invertebrates were observed in other portions of the Site with arsenic concentrations in sediment as high as 1,200 mg/kg. In Section 2.2.3.3 for the FS under "Protection of the Environment", USEPA states:

> **"These results indicate that the toxicity and impairment to benthic invertebrates in HBHA Pond are likely related to the forms of metals in the sediment having higher toxicity and/or bioavailability than the same metals present in sediments downstream. "**

However, they do not present evidence of this rationalization in the FS, and the only evidence they present in the BERA is higher arsenic: iron ratios in sediment at the deeper pond locations (SD-MC-05 and SD-MC-07) only (Table 1). The arsenic:iron ratio and other sediment characteristics at the shallow station in HBHA Pond, SD-MC-06, were similar to those in the downstream sediment samples that had higher arsenic concentrations but no evidence of toxicity.

Figures 1 through 5 are scatter plots of the sediment arsenic data vs. the sediment toxicity data. USEPA's proposed PRG is shown as a red line on each figure. These plots demonstrate that the:

- **PRG of 273 mg/kg is arbitrary with regard to the protection of benthic invertebrates; and**
- **Two deep pond stations, SD-MC-05 and SD-MC-07, are very different from the remainder of the sediment triad sampling stations. These stations are different in habitat type and quality as well as in sediment toxicity.**

In Appendix 7D of the BERA, USEPA performed multivariate analyses of the benthic invertebrate data to evaluate possible correlations among those data, habitat quality information, and the ratio of arsenic:iron concentrations in sediment as a surrogate for potentially available arsenic. They used correspondence analysis and canonical correspondence analysis to perform this evaluation. Their results indicated that the two deep water locations in HBHA Pond were dissimilar with regard to benthic community in comparison to any other site or reference sampling location. When these two stations were taken out of the analysis, the greatest correlations were found between benthic community and habitat quality measurements (acid volatile sulfide concentration in the sediment, water depth, dissolved oxygen content of the overlying water, flow regime, and total organic carbon (TOC)). This indicates that these factors have a greater effect on the benthic invertebrate population in HBHA than contaminant concentrations.

2.3 Arsenic Concentrations in HBHA Pond Outflow do not Exceed NRWQC

The NRWQC for arsenic are not exceeded in the oxygenated surface water and surface water outflow from HBHA Pond. The Multiple Source Groundwater Response Plan Remedial Investigation (RI) report (TTNUS, 2005) included 461 analyses of surface water samples collected throughout the site (not including Reference Areas) under baseflow and storm conditions and analyzed for dissolved arsenic among other parameters. Dissolved arsenic did not exceed NRWQC in any of these samples reported in Tables 4-5e through 4-5i the RI report nor in the data used in the BERA.

Dissolved arsenic concentrations above the chronic NRWQC of 150 ug/l were only detected in water below the oxic/anoxic interface (Ford, 2004; included as Appendix 2D of the RI). Dissolved arsenic concentrations above the NRWQC are confined to the deeper depths within the pond. Dissolved arsenic from the anoxic zone diffuses upward toward the oxic zone and is sequestered during oxidation and precipitation of ferrous iron at the oxic-anoxic interface (Ford, 2004). Under current conditions, the HBHA Pond is continually sequestering arsenic from the bottom anoxic waters. Dissolved arsenic is not exceeding its chronic NRWQC in the oxygenated surface waters and is not being transported out of HBHA pond at concentrations above the NRWQC.

2.4 HBHA Pond Wetland Functions Protected under Current and Proposed Conditions

Wetland functions are being protected in the HBHA Pond under current conditions and would be also under USEPA's Proposed Plan. Therefore, wetland replication is not needed as part of any proposed remediation.

Massachusetts Wetland Regulations (310 CMR 10) list eight interests of wetlands to be protected. Federal and Massachusetts wetland regulations are Applicable or Relevant and Appropriate Requirements (ARARs) for the site. In addition, Massachusetts Department of Environmental Protection (MADEP) guidance for ecological risk assessment (MADEP, 1996), states that each risk assessment must compare concentrations of oil and hazardous material at or from the site to Applicable or Suitably Analogous Standards. MADEP guidance identifies Massachusetts Wetland Regulations as Applicable or Suitably Analogous Standards for wetlands.

HBHA Pond in its current condition provides the following seven functions (interests) regulated under the Massachusetts Wetland Regulations:

- **Flood control;**
- **Storm damage prevention;**
- **Prevention of pollution;**
- **Protection of public and private water supply;**
- **Protection of ground water supply;**
- **Protection of fisheries; and**
- **Protection of wildlife habitat.**

The wetland function "protection of land containing shellfish." does not apply to HBHA Pond.

The HBHA Pond in its current condition provides the functions of protection of public and private water supply, protection of ground water supply and prevention of pollution. The bottom of the Pond is anoxic, and benzene that reaches the Pond in groundwater, is biodegraded in the bottom waters. The Pond also serves as an arsenic sink to prevent the further downstream migration of arsenic.

The HBHA Pond was designed to protect the interests of flood control and storm damage prevention, and continues to provide these functions under current conditions.

In its current condition, HBHA Pond does not provide the wetland function of protection of fisheries, except for downstream areas. The pond itself does not provide quality habitat for recreational species of fish, as stated in Section 5.2.2.2 of the BERA, which listed the reasons for this as poor spawning habitat, low dissolved oxygen, poor overwintering habitat, and lack of submerged aquatic vegetation. However, for the most part, the Pond is preventing the further downstream migration of contaminants, and hence protecting fisheries downstream. The same is true for the wetland function of protection of wildlife habitat.

Therefore, wetland functions are being protected in the HBHA Pond under current conditions and therefore, wetland replication is not needed as part of the proposed remediation.

2.5 References

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3.0 Comments on USEPA's Proposed Plan for Groundwater

Major flaws in USEPA's proposed alternative HBHA-4 relating to arsenic removal in Halls Brook Holding Area (HBHA) Pond identified by Camp, Dresser and McKee are summarized in the following bullet list and then discussed in more detail:

- **The chemocline, in particular the "oxic-anoxic interface" which is one of the processes responsible for arsenic removal, is not "broken down" in the northern end of HBHA Pond during storm events. The oxic-anoxic zone is maintained and is effective in removing arsenic under all conditions. Therefore, construction of a stormwater bypass, sediment retention cell and surface water polishing cell is not necessary or appropriate to maintain the chemocline (in particular the oxic-anoxic transition) and the associated arsenic removal processes in the HBHA Pond.**
- **The two arsenic removal mechanisms occurring in HBHA Pond (1: "sorption to suspended solids produced by iron oxidation-precipitation" and 2: "sorption to solids deposited in the sediments") are effective in removing arsenic from the groundwater as it enters the northern end of the pond. These removal processes are effective in removing arsenic from the groundwater and pond water even during storm events. The second arsenic removal process, sorption onto and removal of the arsenic by the existing sediments in the HBHA Pond, was not adequately evaluated in the Draft Feasibility Study and Proposed Plan. The available, site-specific data showing the long term effectiveness and adsorption capacity of the sediments were not considered by USEPA. Removal of sediments from the HBHA Pond will destroy an effective and important arsenic removal.**

3.1 Stability of the Chemocline in the Northern End of the HBHA Pond

The Draft Final MSGRP Feasibility Study (FS) (USEPA, 2005) and USEPA's Natural Attenuation Study (NAS) (Ford, 2004) identify and call the chemical changes with depth in HBHA Pond the "chemocline". In removing arsenic (see discussion in Section 3.2), the most important aspect of the chemocline is the transition from the oxic to anoxic zone as discussed in the previous paragraph. According to the Draft FS, "This chemocline is critical to sustaining geochemical reactions that are sequestering arsenic within the pond sediments. However, sudden increases in flows, as seen during storm conditions, mix the water column and break down the chemocline thus allowing more arsenic to be "flushed" downstream." (Draft FS, pg 3-29). Contrary to USEPA's conclusion and actual data collected by USEPA after a storm event, the chemocline is not broken down in the northern end of the pond. Immediately following the late March 2001 storm, the oxic-anoxic transition depth was measured in the north part of the pond (WN data, NAS, Table C-11, pg 79) in the water column and in the multi-level sampling station (NML data, NAS, Table C.14, pg 82). The water column measurements (WN data, Table C-11) indicate that the oxic-anoxic transition depth was from 200 - 250 cm (as measured by ORP; no DO measurements were made) and the multi-level measurements indicate that the transition depth was between 220 – 270 cm (as measured by ORP and DO). The oxic zone may have been slightly deeper immediately after the storm as a result of more oxygenated surface water runoff entering the pond. Overall, the important transition from anoxic to oxic conditions still existed in the pond and was not "broken down". In fact, the slightly deeper location of the oxic layer is beneficial in removing the arsenic at a lower depth in the pond. Even if more complete mixing occurred with storm water resulting in more and deeper oxic water, the transition zone would still be present and the arsenic removal would occur at an even greater depth in the pond.

The overall break down of the chemocline has been overstated in the FS. Ford (NAS, pg 49) indicates the "high surface water flow events can perturb the chemical stratification". Actual data following the March 2001 storm event (NAS, figure 7, pg 32) do indicate some depth shift in Specific Conductance between 200 and 350 cm and in dissolved arsenic between 200 and 420 cm. However, the overall transition is still maintained through all sampling events: specific conductance is uniform from the surface to a depth of about 200 cm and then increases; arsenic concentrations are very low (0.010 mg/L) or ND (non-detect) from the surface to the transition depth of about 200 cm (the depth of the anoxic zone) and then increase. As a result of the increase in depth of the oxic zone following the storm event, the arsenic concentration was also below detection limits at a deeper depth (NML-4 on 4/5/01, NAS, pg 82). The Draft Final MSGRP Remediation Investigation (RI) Report (USEPA, 2005) states, "A major surface water runoff event occurred during the study. This resulted in turnover of most of the pond volume and depression of the chemocline at the north end of the pond" (RI, pg 5-34). As stated previously, the chemocline was not broken down in the northern end of the pond, but only depressed (transition zone occurred at a lower depth). This observation is consistent with the actual data collected.

As discussed in detail in the following section, the two arsenic removal processes identified in the FS and the NAS are effective even during and after storm events. Therefore, construction of a stormwater bypass and the Sediment Retention Cell, as proposed in USEPA's Proposed Plan, is not necessary to maintain the chemocline and associated arsenic removal processes. The Surface Water Polishing Cell included in USEPA's Proposed Plan will not remove additional arsenic and is not necessary. The polishing cell is designed to "create a secondary treatment zone that would be utilized to "polish" surface water that leaves the sediment retention area through the use of aeration and sedimentation" (Draft FS, pg 4-28). However, the surface water in the upgradient Sedimentation Retention Cell would be oxic absent any bypass of Halls Brook and contain no reduced iron which is necessary for arsenic removal. Therefore, the Surface Water Polishing cell will provide no additional arsenic removal and is not necessary.

3.2 Arsenic Removal Processes in HBHA Pond

The Natural Attenuation Study (Robert Ford, Natural Attenuation Study, Industri-Plex Superfund Site, September 2, 2004) summarizes the arsenic removal processes in the HBHA Pond: "The mass of dissolved arsenic in the HBHA Pond water column is controlled by a balance between the observed sources and removal processes.... Removal 1) sorption to solids deposited in the sediments 2) sorption to suspended solids produced by iron oxidation-precipitation 3) discharge at the HBHA Pond outlet." (NAS, pg. 39). The first removal process (sorption to pond sediments is discussed in a subsequent paragraph below. The second removal process (sorption to hydrous iron oxides produced by iron oxidation and precipitation) is discussed in the following paragraph.

As stated in the FS and NAS, arsenic continues to diffuse upward from the bottom sediments into the water column where it can be "further sequestered from solution during oxidation and precipitation of ferrous iron at the oxic-anoxic interface" (Draft Final Feasibility Study, Industry-Plex Site, June 2005, pg 1-21). The arsenic is effectively removed from the water column by oxidation of dissolved Fe^{2+} (ferrous iron) to Fe^{3+} (ferric iron), formation of hydrous ferric oxides (HFOs, solid precipitates) and adsorption (removal from solution) of dissolved arsenic onto the HFOs. This process is controlled by the dissolved oxygen (DO) content of the water column. The DO content in the water column in the northern portion of the pond is very low (<1 mg/L) near the bottom of the pond and increases upward to the surface. In the lower part of the water column, the water is reducing (low oxidation/reduction potential (ORP) values) and has elevated concentrations of Fe^{2+}. At the "oxic-anoxic" transition, formation of HFO occurs due to oxidation of the reduced iron and arsenic is removed by adsorption. The depth of the oxic-anoxic transition zone varies somewhat during the year; however in the north part of HBHA pond, the transition depth is typically 200 to 250 cm.

Sediments in the HBHA provide a second important arsenic removal process in the HBHA Pond. This process should be maintained and not disturbed by dredging. As discussed in the Draft FS, "A fraction of the dissolved arsenic being discharged from groundwater in the HBHA Pond sediments becomes bound to ferric oxides and effectively removed from the water column and becomes part of the sediment load." (Draft FS, pg 1-21). "Sediments solids rich in iron, sulfur and organic matter sequester a fraction of the total arsenic at the sediment-water interface." (NAS, pg 39). Although the sediments provide an important arsenic removal function, the NAS indicates that there is "incomplete removal onto sediments" and "It is unclear which of these phases control arsenic partitioning during deposition" (NAS, pg 39). However, the arsenic removal mechanisms and capacity of the HBHA Pond sediments have been previously evaluated using electron microprobe techniques (Supplemental Site Investigation Report, Industri-Plex Site, September 1997, pp 51 – 52), which are included at the end of this section, and batch adsorption tests (Supplemental Site Investigation Report, pp 53 – 55). The Supplemental Site Investigation Report found that natural iron containing minerals in the HBHA Pond sediments were important in removing arsenic from groundwater and that the average removal capacity was over 3,000 mg As/kg of sediment. The NAS (pg 48) indicates that "...it is difficult to assess the long-term capacity of the HBHA Pond." However conservative estimates using the results of the Supplemental Site Investigation Report indicate that the pond sediments will continue to remove arsenic for several hundred years. Recent evaluations of the concentrations of arsenic and iron in the pond sediments (Table F.1 – F.4, NAS, pp 96-99) confirm high iron content in the sediments that can continue to adsorb additional arsenic above the measured concentrations for many years. In addition, the input of suspended solids (TSS) with natural iron containing minerals to the HBHA Pond via Hall's Brook and other waters during normal and high flow events continue to provide additional adsorption sites and arsenic removal capacity.

That is, the suspended solids in the surface waters settle in the HBHA Pond creating more iron rich sediments in the bottom of the pond. Bypassing Halls Brook during storm events will remove an important source of iron-rich sediments.

Removal of sediments from the HBHA Pond, as proposed in USEPA's Proposed Plan, will destroy an effective and important arsenic removal process and is not necessary to prevent arsenic migration from the HBHA Pond. Existing pond sediments provide an important arsenic removal function that continues to be effective. This important function should not be destroyed by removing sediments. Since it is inappropriate and unnecessary to remove sediments from HBHA Pond, installation of a liner in the New Boston Street Drainway to prevent migration of arsenic-containing sediments to the Pond is not necessary. Lining the Drainway will cut off a source of iron-containing minerals which are critical to continued arsenic removal in HBHA Pond.

3.3 References

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4.0 Comments on USEPA's Proposed Plan for Surface Water

USEPA's Proposed Plan for sediments in Halls Brook Holding Area is fatally flawed and should not be selected for implementation because:

- **HBHA Pond and Wetland are effectively controlling downgradient transport of arsenic. USEPA's Proposed Plan would alter the entire hydraulic regime of the HBHA system, resulting in the loss of important flood mitigation functions and arsenic sequestration and attenuation processes;**
- **Installation of Coffer dams in HBHA Pond will adversely affect arsenic removal by reducing the settling capacity of HBHA and thereby decrease its ability to precipitate and sequester arsenic as groundwater discharges to surface water;**
- **Unmitigated flows from the Atlantic Avenue Drainway and the ephemeral stream draining NStar Right of Way (ROW) No. 9 could re-suspend and flush precipitated and sequestered arsenic from the sediment retention cell created by installation of the cofferdams across HBHA Pond. Unlike now, sediments flushed from the sediment retention cell would be transported downstream to HBHA Pond, kept in suspension by the Halls Brook stormwater bypass and transported downstream to HBHA Wetland and the Aberjona River;**
- **Low density hydroxide floc and adsorbed arsenic in the Sediment Retention Cell will be re-introduced into the water column during spring and fall turnover and transported downgradient to HBHA Pond and Wetland areas by storm events;**
- **Installation of a stormwater bypass structure at the confluence of Halls Brook with HBHA Pond would eliminate delivery of iron-rich sediments to the sediment retention cell created by installation of the Coffer dams across HBHA Pond and decrease the Pond's effectiveness in precipitating and sequestering arsenic;**
- **Installation of Coffer dams in HBHA Pond, in conjunction with the stormwater bypass of Halls Brook, will significantly alter the current hydrologic regime of Halls Brook Holding Area, which is effectively attenuating 100-year runoff velocities and volumes, and potentially exacerbate upstream flooding in the Atlantic Avenue Drainway and adversely affect downstream flood control in the Aberjona River.**

4.1 HBHA Effectively Controls Downgradient Transport of Arsenic

The finding of the Multiple Source Groundwater Response Plan (MSGRP) RI/FS acknowledged that the current HBHA system is attenuating and sequestrating arsenic entering the Pond via ground water inflow. The present level of performance is largely attributable to the unique hydrogeochemical features currently operating in the system. The depositional environment created and maintained by the long length to width ratio of the Pond in conjunction with the velocity mitigating effects of the Ponds bathymetry and flat hydraulic grade are collectively responsible for the arsenic sequestration performance evidenced in the Pond to-date. These unique features, in combination with the velocity mitigation, storage and depositional environment provided by the downgradient Wetlands have collectively functioned to minimize the downstream transport of arsenic from the HBHA system.

USEPA's Proposed Plan would partition the Pond into hydraulically isolated basins and divert Halls Brook stormwater inflows to a Southern Pond Basin. As discussed in the following sections, this in effect would alter the entire hydraulic regime of the HBHA system resulting in the loss of important flood mitigation functions and arsenic attenuation potentials. For these two reasons alone, the USEPA's Proposed Plan is ill-advised and should not be implemented as designed.

4.2 Pond Partitioning Will Adversely Effect Arsenic Removal

The HBHA was designed as a flood mitigation system. However, the flat hydraulic grade and Pond/Wetland sequence have created an excellent environment for sediment deposition and arsenic sequestration. This is evidenced by the accumulation of approximately 14,000 cubic yards of sediments since its initial construction in the early 1970s. The bathtub-like bathymetry of the Pond in conjunction with its long length to width ration (i.e., 7:1) provide the hydraulic retention time needed to settle both course and fine grained sediments from the water column (Schueler, 1992, Horner, 1990, Yousef et al. 1986, 1991). Sediment depositional bathymetry was delineated during the Groundwater/Surface Water Investigation Plan (GSIP) investigation. Findings reflect a relatively uniform deposition pattern along the axis of the Pond (Roux Associates, 2002). This is largely attributable to the points of tributary inflow to the Pond, differential-settling velocities of sediments of varying compositions and densities, and importantly, the hydraulic features displayed by the Pond under extreme runoff conditions. Geotechnical data indicate that the finer low-density sediments are accumulating near the outlet of the Pond, with coarser sediments settling immediately downgradient of tributary inflow points. While some sediment mounding is observed at these locations, interim natural forces are periodically redistributing these sediments across the Pond bottom (Roux Associates, 2002)

The installation of the proposed Coffer dams across the Pond would partition the Pond into two retention basins (i.e., North (Sediment Retention Cell) and South Basin), with each basin displaying new hydraulic and depositional features. The new North Basin (Sediment Retention Cell) would display a length to width ratio of approximately 2:1 and the remainder of the Pond would have a 3:1 ratio. Under stormflow conditions, the proposed reduction in length to width ratios could significantly affect the settling capacity of fine grained sediments thereby increasing sediment delivery to downstream areas (Horner, 1990). An evaluation of sediment transport was not performed as part of the MSGRP RI/FS. Thus, the effects of the proposed remedy on sediment deposition, re-entrainment and transport to downstream areas remain undefined. Given the acknowledged association between Total Suspended Solids (TSS) and arsenic export from the Pond, the omission of sediment transport analyses precludes any credible projection of remedy performance.

4.3 Storms Will Flush Sediments from Sediment Retention Cell

The approximate 11-acre HBHA system was designed to mitigate flood flows from storms of up to 100-year recurrence frequency. This is evidenced by the flat hydraulic grade (0.0054%) and low peak velocities reported int eh 1980 FEMA Flood Insurance Study Report (FEMA, 1980). The storage and buffering capacity of the Pond and contiguous Wetlands system, in conjunction with a flat hydraulic grade, has effectively mitigated runoff events of various size and duration. However, interim land use changes within the HBHA's contributing watershed have increased peak runoff rates and volumes thus affecting the hydraulic performance of the system (VSB, 2003). As discussed below, the arsenic mitigation strategy incorporated in the USEPA's Proposed Plan will likely be subject to periodic up-set and flushing via stormwater inflows from the Atlantic Avenue Drainway and the NStar ROW No. 9 drainage culvert. Similarly, re-suspended hydroxide floc transported to the Southern Basin will be flushed downstream by flows from the Halls Brook bypass. The intensity of these flushing flows will increase as development within the Pond's contributing drainage basin increases. Consequently, USEPA's Proposed Plan will remain susceptible to periodic flushing events and hence will continue to export sediment from the HBHA system. For this reason, USEPA's Proposed Plan is ill-advised and should not be implemented.

The new North Basin (Sediment Retention Cell) will be subjected to direct inflows from the Atlantic Avenue Drainway and the ephemeral stream draining NStar ROW No. 9. Collectively, these two inflow points drain approximately 45 percent of the area discharging to the Pond (MSGRP RI, 2005). During major storm events, runoff entering the basin from these sources will be significant and unmitigated. As evidenced by runoff hydrographs generated from the 5.31-inch precipitation event that occurred on March 22-24, 2001, peak inflows from the Atlantic Avenue Drainway approached 90 cubic feet per second (cfs), while the NStar ROW No. 9 culvert peaked at over 20 cfs (Roux Associates, 2002). The 5.31-inch event, while significant, corresponded to a design storm with a recurrent frequency of only 10 years (NCRS, 1986). Peak inflows from a 100-year event would be substantially greater. Ultimately, the flushing effects associated with large design storms would significantly and adversely affect the performance of the USEPA's Proposed Plan .

4.4 Downstream Transport of Low-Density Hydroxide Floc

Arsenic-containing iron hydroxide floc will form when reduced water in the bottom of the Sediment Retention Cell encounters the oxic/anoxic transition zone. Hydrous ferric oxides will form at the oxic/anoxic transition zone as reduced ferrous (Fe^{+2}) iron encounters oxygenated water, oxidizes to ferric Fe^{+3}) iron and precipitates as hydrous ferric oxide (HFO) floc (Skousen and Ziemkiewicz, 1995). Arsenic sorbs to the HFO floc, which would accumulate in the bottom of the Sediment Retention Cell.

Flushing flows into the Sediment Retention Cell from the Atlantic Avenue Drainway (90 cfs) and the ephemeral stream draining NStar ROW No. 9 (20 cfs) during major storm events would likely disrupt the chemocline and flush arsenic-bearing HFO floc to downgradient locations. The shortened length to width ratios created by the partitioning Coffer dams and the bypass of Halls Brook would significantly reduce TSS settling efficiency in the Southern Basin thereby increasing the export of the low density floc materials to downstream locations. The length to width ratios will shorten the amount of time and distance fine grained sediments will have to effectively settle out of the water columns. Similarly, the loss of the Northern pond area to Halls Brook inflows during stormwater runoff periods will eliminate the hydraulic buffering capacity, shorten available sediment settling time and convey higher sediment loads directly to the pond outlet from a re-directed Halls Brook (i.e., the by –pass option).

Perhaps more importantly, storms of lesser intensity occurring immediately after spring and fall turnover would export the re-entrained floc to the South Basin and similarly transport the arsenic bearing TSS downstream via the mechanisms discussed above. Turnover occurs in lakes and ponds deep enough to thermally stratify. In essence, as water cools in the fall, density differentials in the water column cause the cooler surface water to sink displacing warmer bottom water. This "turnover effect" results in a completely mixed water column that reintroduces low-density sediments present in the bottom of the Pond uniformly throughout the water column. The water will thermally re-stratify during the colder winter periods. During late winter ice-out conditions, the surface water warms to maximum density (i.e. $4^{\circ}C$), subsequently sinks to the bottom resulting in a spring turnover event. Similar complete water column mixing occurs until thermal stratification is re-established and water column stability returns (Wetzel, 1975, Tchobanogious and Schroeder, 1987). Even in the event that some of this material is re-deposited in the South Basin, it would be subject to re-entrainment and flushing during storm events via the high velocity inflows from the Halls Brook bypass option.

For these reasons, USEPA's Proposed Plan is ill-conceived and ill-advised.

4.4 Halls Brook Bypass Will Negatively Impact Arsenic Removal

A significant flaw in USEPA's Proposed Plan is the loss of future iron-rich sediment delivery to the proposed North Basin (Sediment Retention Cell). The elimination of the continuous supply of iron-rich organic materials from Halls Brook inflows during storm events could adversely impact the arsenic sequestration and attenuation processes in the Sediment Retention Cell. The potential effects of removing this source of iron on the long-term performance of the proposed remedy was neither evaluated nor discussed in the MSGRP Feasibility Study. For this reason, USEPA's Proposed Plan should not be implemented.

Another negative effect of the proposed Halls Brook stormwater bypass would be the elimination of a continuously oxygenated water supply to the proposed Sediment Retention Basin. As the sole perennial stream entering the Pond, Halls Brook is the major source of dissolved oxygen delivery to the water body. Given the importance of maintaining aerobic conditions in the Sediment Retention Cell for arsenic removal, the proposed bypass of stormwater inflows to the southern basin of the Pond could significantly effect the long-term maintenance of aerobic conditions within the proposed basin. Ultimately, this could result in the periodic development of anaerobic conditions within the basin and significantly effect arsenic removal performance. An evaluation of the oxygen demand needed to sustain the proposed system and the subsequent effects of removing a major oxygen supply source (i.e., Halls Brook) were not addressed in the USEPA's Proposed Plan evaluation.

4.5 Flooding Effects Not Evaluated

USEPA's Proposed Plan includes the installation of Coffer dams at two locations in the northern portion of the HBHA Pond. The Proposed Plan also includes the bypass of Halls Brook downgradient of the dams. Placement of the Coffer dams as proposed would hydraulically isolate approximately 40 percent of the Pond area from Halls Brook inflows. The resultant retention basin created north of the dams would be subject to surface water inflows from the Atlantic Avenue Drainway and from a culvert draining the business park area located east and slightly north of the Pond. An evaluation of potential upstream flooding effects created by the proposed dams and the potential downstream flooding effects created by the proposed bypass of Halls Brook was apparently omitted from the MSGRP Remedial Investigation and Feasibility Study. Given the history of serious flooding in the Cities of Woburn and downstream Winchester, and the fact that the HBHA system was designed exclusively for flood mitigation purposes, the omission of an evaluation of flooding-related impacts of USEPA's Proposed Plan constitutes a serious flaw that should preclude selection and implementation of this plan.

The HBHA Pond and Wetland system was constructed in the early 1970s as a flood control project to replace the filled-in Mishawum Lake. As stated in the RI, the HBHA was designed as a flood control project. The hydraulic design of the system results in very low flow velocities (i.e. from 0.1 to 0.3 feet per second) for storms of up to 100-year recurrence frequency (FEMA, 1978). Very low flow velocities during storm conditions are due to the bathtub-like design of the Pond (long and narrow with steep sides and a high inlet and outlet), the flat hydraulic grade of the Wetlands, and flow restrictions at the Mishawum Road outlet. Collectively, these features have limited "flushing flow" events to storms of significantly greater magnitude then a 100-year storm, and have established and maintained a stable depositional environment in both the Wetlands and Pond.

Flooding along Halls Brook and the Aberjona River prompted the completion of two recent studies by the US Army Corps of Engineers (USACE) and the Federal Emergency Management Agency (FEMA). The first study, commissioned by the ACOE, evaluated hydrologic/hydraulic conditions along the Middlesex Canal and Halls Brook. The study was performed by Vanasse Hangen Brustlin, Inc. (VHB) in 2003. Applicable findings reported an increase in 100-year peak discharges to the HBHA Pond from Halls Brook of from 420 cfs (FEMA, 1978) to 1,120 cfs (VHB, 2003). This significant increase in peak Pond inflow rates is attributed to "recent development in the study area" and possibly "substantial flows coming from the industrial area in Wilmington" entering Halls Brook at the Boston and Maine Railroad. The velocity of Halls Brook at the point of Pond discharge was not provided although the 1978 FEMA Study lists this at 7.1 feet per second (fps). This high velocity is currently mitigated by the Pond as evidenced by the 0.3

fps velocity reported for the Pond outlet during 100-year runoff conditions.

USEPA has failed to evaluate outlet velocities that would result from its Proposed Plan. The loss of 40 percent of the Pond area through installation of the proposed Coffer dams in conjunction with the proposed Halls Brook bypass remedy will significantly lessen the velocity mitigating effects of the Pond during design storm runoff conditions. Higher velocities would result in scouring, entrainment and transport of Pond sediments to downgradient locations. USEPA's Proposed Plan would also result in the loss of 40 percent of the Pond's storage capacity thereby increasing the likelihood of downstream flooding.

A second study of flooding conditions along the Aberjona River was commissioned by FEMA and performed by ENSR International, Inc. to update the 1978 FEMA Flood Insurance Study (FIS). The study was initiated in 2002 and is still underway. Extensive hydraulic and hydrologic modeling of Halls Brook and the Aberjona River were performed as part of the study. Preliminary results indicate a 0.57-foot increase in the 100-year Base Flood Elevation (BFE) at the Mishawum Road outlet (ENSR, personal communication, 2005). The corresponding increase for a 500-year storm is reported at 1.85 feet. These increases represent the effects of development in the HBHA contributing watershed since completion of the 1978 FEMA Study and clearly indicate that HBHA is handling higher flows than it was originally designed for.

Flooding is a major concern of the local communities. Given these higher flows and the frequency and impacts of downstream flooding, any proposed remedy that would alter the hydraulic performance of a flood control system like the HBHA should be subjected to extensive hydraulic analyses to ensure that USEPA's Proposed Plan does not exacerbate flooding in the future. In discussions with local USACE and FEMA representatives responsible for the two flood-related studies identified above, both groups acknowledged that they were not contacted by the USEPA or its designated consultant (TetraTech NUS, Inc.) to discuss potential flooding associated with implementation of the Agency's Proposed Plan (William Mullen, USACE, personal communication, 2005; Mark Otis, USACE, personal communication, 2005;; Jim Herberich, ENSR, personal communication, 2005). The absence of a flood-impact analysis for the Proposed Plan constitutes a fatal flaw because it does not ensure that downstream communities will not be subjected to greater flooding.

The preceding discussion underscores the design and performance uncertainties associated with the USEPA's Plan as proposed. The installation of the Coffer dams across the Pond will certainly reduce the length to width ratios resulting in reduced sediment settling efficiencies. The Halls Brook bypass will similarly reduce iron-bearing sediment delivery to the North Retention Basin, reduce the delivery of oxygen bearing water to the North Basin, exacerbate downstream flooding potentials through the loss of approximately 40 percent of the Pond's storage volume and increase the export of potentially arsenic-bearing sediments to downstream locations. Collectively, these flaws preclude the viability of the USEPA's Proposed Plan.

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5.0 Comments on USEPA's Proposed Plan for Sediments

5.1 Halls Brook Holding Area Pond Sediments

USEPA's Proposed Plan for sediments in Halls Brook Holding Area Pond should not be implemented for the following reasons:

- **Dredging is not an effective risk-reduction technology;**
- **The dredging alternative will not create a viable benthic organism habitat in HBHA Pond;**
- **Scouring during storm events is not re-suspending and transporting HBHA Pond sediments;**
- **USEPA significantly underestimated the volume of sediments in HBHA Pond.**

USEPA's Proposed Plan for the arsenic-impacted sediments in the Halls Brook Holding Area (HBHA) Pond (Alternative HBHA-4) includes, among other elements, dredging approximately 6,700 cubic yards of sediments from the southern end of the pond. The dredged sediments would then be dewatered and transported off-site for disposal. The northern portion of the pond is proposed by USEPA to be used as a sediment retention basin, and would need to be dredged periodically to remove accumulated sediment.

While dredging can be used to remove contaminated sediments, dredging the HBHA Pond is ill-advised for a variety of reasons. First, while dredging can remove sediment mass, it is not necessarily an effective technology when it comes to risk reduction; in fact, at a number of sediment sites, dredging has resulted in higher concentrations of the constituent of concern in surface sediments after implementation. As a result, the risks are increased as opposed to decreased.

Second, although one of USEPA's goals of Alternative HBHA-4 is to provide an improved benthic habitat in a portion of the pond, dredging, no matter how effective, will never contribute to this end. The HBHA Pond is a man-made structure designed to retain stormwater, and its bottom is prone to anoxic conditions. Even if all the arsenic-containing sediments were removed, anoxia would likely continue, preventing the development of thriving communities.

Third, the primary transport mechanism assumed in the Feasibility Study (FS) is scouring of the arsenic-containing sediment from the bottom of the pond and downstream migration of these sediments. This, however, is not the case. Rather, the sediments in the HBHA Pond sorb arsenic entrained in groundwater as the groundwater discharges to the surface water. Further, hundreds of years of sorptive capacity remain in the sediments. *Dredging these sediments would actually destroy an effective,* functioning arsenic removal mechanism. In addition, since surface water velocities in the pond are quite low (a result of the pond's design as a retention basin), sediments are not scoured and transported downstream with any regularity.

Finally, USEPA significantly underestimated the volume of sediments that would be dredged from the southern portion of HBHA Pond if its Proposed Plan is implemented. USEPA's 6,700 cubic yard estimate of sediment volume was derived by multiplying the areal extent of the HBHA Pond south of the proposed northern cofferdam (135,000 square feet) by an assumed average sediment thickness of 1.33 feet (roughly equivalent to the 41-centimeter average sediment thickness of the 1991 GSIP Phase 2 Remedial Investigation data set). During implementation of the Final GSIP Scope of Work (SOW) in 2001, sediment thickness was measured at 22 locations throughout the HBHA Pond. Using this sediment thickness data, the portion of HBHA Pond to be dredged under USEPA's Proposed Plan contains approximately 10,000 cubic yards of sediments, almost 50 percent more than the sediment volume (6,700 cubic yards) used in the Proposed Plan to determine the costs for performance of this remedial action. Since sediment removal costs constitute a substantial proportion of the total capital costs for the HBHA Pond remedial action, USEPA significantly underestimated the cost of implementing its Proposed Plan.

For all of these reasons, implementing USEPA's Proposed Plan for dredging arsenic-containing sediments from the HBHA Pond is not likely to be an effective remedial action.

5.2 Wells G&H Wetland and Cranberry Bog Conservation Area Sediments

USEPA's Proposed Plan for excavation and removal of near-shore sediments in the Wells G & H Wetland and the Cranberry Bog Conservation Area should not be implemented for the following reasons:

- **Capping of near-shore sediments with arsenic concentrations greater than Preliminary Remediation Goals (PRGs) will not increase access to impacted sediments in deeper water areas in the Wells G&H Wetland because access to these areas is already restricted by existing physical impediments;**
- **Caps designed to prevent dermal contact can be built so that increases in grade elevation are kept to a minimum; and**
- **Access to capped areas, and/or deeper water sediments, can be controlled using biological barriers to supplement existing dense vegetation.**

In the FS, USEPA eliminated *in situ* capping as a remedial technology because it allegedly would increase access to deeper wetlands in the Wells G & H Wetland. USEPA's preferred alternative relies on institutional controls (Alternative DS-2) to prevent future worker exposure to arsenic-containing sediments in deeper wetland areas within the HBHA Wetland and Wells G & H Wetland. USEPA's concern with *in situ* capping increasing access to deeper sediments would seem to presume a simplistic capping remedy that would essentially create mounds of soil over the proposed remedial areas.

There are several flaws in this reasoning, which led to screening out what should have been retained as an effective remedial technology. First, Wells G & H Wetland near shore sediments targeted for remediation are not easily accessible. The existing dense vegetation and adjoining rifle range make this wetland both difficult and potentially dangerous to access. Existing potential physical hazards pose far greater impediments to accessing deeper areas within the Wells G & H Wetland than potential access facilitated by above-grade *in situ* capping.

Second, caps can be designed to provide dermal barriers to exposure without excessive thickness (e.g., incorporation of geotextiles). Because the proposed remedial areas are relatively confined, caps placed over wetland sediments would likely settle, keeping increases to the existing grade elevation to a minimum.

Third, USEPA's concerns regarding potential access to deeper sediments as a result of capping could be effectively addressed through use of additional biological barriers to supplement the existing dense vegetation (i.e., planting vegetation containing briars/thorns while avoiding those that produce edible fruits [e.g., blackberry]).

For these reasons, USEPA's Proposed Plan for near-shore sediments should not be implemented.

5.3 References

Tetra Tech NUS, Inc., 2005. Draft Final Feasibility Study, Remedial Investigation/Feasibility Study, Industri-Plex Site, Woburn, Massachusetts.

Roux Associates, Inc., Environmental Science and Engineering, Inc., and PTI Environmental Services, 1992. Ground-Water/Surface-Water Investigation Plan, Phase 2 Remedial Investigation Draft Report.

Roux Associates, Inc., 2002. Final GSIP Scope of Work Volume 4, Downgradient Transport Draft Report.

6.0 Comments on USEPA's Proposed Plan for the West Hide Pile

Based on Roux Associates' review of USEPA's Proposed Plan and the Administrative Record documentation, USEPA's selected groundwater remedy for the West Hide Pile is seriously flawed and should not be implemented because:

- **No remedial action is needed at the West Hide Pile to protect public health because potential future human health risks associated with groundwater impacts at the West Hide Pile can be adequately addressed through implementation of institutional controls—as recognized in the Draft Final Feasibility Study Report and in the Proposed Plan and discussed in Section 1.0 of this document—and because the Custodial Trust owns the land and will not allow groundwater use for industrial or car wash purposes.**
- **No remedial action is needed to protect the environment because there are no documented unacceptable current or potential future ecological risks associated with groundwater impacts at the West Hide Pile (including discharge to surface water). In addition, benzene concentrations in groundwater at the West Hide Pile have decreased considerably since the early 1990s via natural processes, with current levels well below the relevant Massachusetts Contingency Plan (MCP) standard for groundwaters discharging to surface water; and**
- **Enhanced in-situ bioremediation cannot be implemented to treat benzene in groundwater at the West Hide Pile as proposed in USEPA's Proposed Plan because of the very high oxygen demand resulting from the presence of soluble organic carbon from hides in the groundwater beneath the West Hide Pile.**

6.1 Human Health Risk Management with Institutional Controls

As discussed in the Draft Final Feasibility Study Report, groundwater at the West Hide Pile contains benzene at concentrations alleged to exceed human health risk-based threshold concentrations for potential future-use scenarios. Although these future exposure scenarios are unfounded hypotheses, any future human exposures to groundwater at the West Hide Pile can be readily prevented or controlled. As recognized in the Draft Final Feasibility Study Report, this can be readily accomplished through the use of institutional controls, which have already been incorporated into all of the groundwater alternatives evaluated during the Feasibility Study except, of course, for the "no-action" alternative. In fact, groundwater use restrictions are already part of the institutional controls (grants of environmental protection) ready for inauguration at the Industri-plex Site.

The protectiveness of institutional controls from a human-health perspective is indicated in the Draft Final Feasibility Study Report as follows:

> **"Alternative GW-2...would provide protection of human health...through institutional controls...." (Page 4-51)**
>
> **"Alternative GW-3...and Alternative GW-4...would also provide protection of human health...through the use of institutional controls." (Page 4-52)**
>
> **"...the level of human health protection provided by [Alternatives GW-3 and GW-4] would be similar to that provided by Alternative GW-2...." (Page 4-52)**

Moreover, as also recognized in the Draft Final Feasibility Study Report, institutional controls by themselves are adequately protective of human health (i.e., without the need for additional remedial measures). For example, Table 3-2 of the Draft Final Feasibility Study Report indicates that of the four remedial alternatives evaluated for groundwater, only the "no-action" alternative would not protect human health in the long term without other measures.

Institutional controls prohibiting groundwater use can be readily implemented at the West Hide Pile because the Custodial Trust owns this property and can place appropriate restrictions in the deed. Commercial, industrial, residential and agricultural development will not be allowed on this property, facilitating enforcement of institutional controls. Therefore, from a human-health perspective, there was no need for USEPA to include enhanced in-situ bioremediation for the West Hide Pile in its Proposed Plan.

6.2 No Ecological Risk from Groundwater Discharge to Surface Water

There are no unacceptable *ecological risks at the Site attributable to benzene in groundwater at the West* Hide Pile, as indicated in the Draft Final Feasibility Study Report:

> **"Once discharged to the sediments and surface water [of Lower South Pond], the benzene [in groundwater at the West Hide Pile] is likely being attenuated by biodegradation, chemical degradation, volatilization, and dispersion as seen in the HBHA Pond." (Page 1-23)**
>
> **"...the only area of unacceptable ecological risk is in the HBHA Pond...." (Page 1-30)**

Benzene concentrations in groundwater at the West Hide Pile have decreased significantly from 1991/1992 to 2002 as shown in the tables below:

OW-31 (9-14')		RX-18 (8-13')		RX-18 (15-20')		RX-18 (25-30')	
6/90	48,000 µg/L	12/02	3,900 µg/L	12/02	4,800 µg/L	12/02	170 µg/L
10/90	36,000 µg/L	12/02	4,100 µg/L				
12/91	63,000 µg/L						
Note: GSIP records also indicate that OW-31 may have been screened from 12-14'.							

WP-3 (0.2-10.2')		RX-19 (8-13')		RX-19 (17-22')		RX-19 (25-30')	
12/91	12,000 µg/L	12/02	3.7 µg/L	12/02	940 µg/L	12/02	51 µg/L
Note: Due to shaping and grading of the West Hide Pile during implementation of the Soil Remedy in the mid-1990's, the ground surface at the location of WP-3 was raised several feet.							

As the data show, benzene concentrations detected in the shallow groundwater interval (8 to 13 feet) at Final GSIP Scope of Work (SOW) locations RX-18 and RX-19 are much lower than the benzene concentrations detected respectively at GSIP Phase 1 and 2 monitoring wells OW-31 and WP-3, which were present at roughly the same locations and which were screened over the same general intervals as their Final GSIP SOW analogues. Current benzene concentrations in groundwater at the West Hide Pile are well below the current and proposed future MCP Method 1 GW-3 standards for benzene (7,000 and

10,000 µg/L, respectively), promulgated for the protection of surface waters into which groundwaters discharge.

Given the absence of any chemical-specific ARARs for Site groundwater (as discussed in Section 2.1.1 of the Draft Final Feasibility Study Report) or any other regulatory driver for groundwater cleanup at the West Hide Pile, the absence of unacceptable ecological risks associated with benzene in groundwater at the West Hide Pile demonstrates that there was no need for USEPA to include enhanced in-situ bioremediation for the West Hide Pile in its Proposed Plan.

6.3 Enhance In-Situ Bioremediation is Technically Impracticable

Since enhanced bioremediation was only evaluated at the process level during the Feasibility Study, USEPA was not able to adequately evaluate its difficulty of implementation, degree of remediation feasible, and cost of implementation over the long run at the West Hide Pile. The Feasibility Study recognized that uncertainty exists regarding the effectiveness of *in-situ* technologies that rely on liquid-delivery systems to treat groundwater (Table 4-12D) and that the aquifer's high organic carbon content—attributable to both natural peat deposits and waste animal hides—could impact the logistics of an in-situ bioremediation remedy (page 3-19). However, no detailed discussion was presented regarding this organic matter's potentially limiting effect on the overall success of the proposed remedy for the West Hide Pile, nor in fact was the specific appropriateness and applicability of ORC™ (Regenesis Oxygen Release Compound) at the West Hide Pile ever supported with Site data. Rather, to address the limited uncertainties identified in the Draft Final Feasibility Study Report, treatability testing was included as an element of the West Hide Pile component of the Proposed Plan. However, it was inappropriate for treatability testing of this type to have been included as an element of a remedial alternative being evaluated in a Feasibility Study, based on USEPA's own guidance ("Guidance for Conducting Treatability Studies under CERCLA",; EPA/540/R-92/071a). This guidance specifies two distinct types of treatability studies (pilot testing):

- **Pre-Record of Decision (ROD) Treatability Studies, conducted to determine implementability, effectiveness, etc., in support of the detailed analysis of a Feasibility Study; and**
- **Post-ROD Treatability Studies, conducted to optimize remedial design.**

The treatability study proposed in the Draft Final Feasibility Study Report is clearly of the pre-ROD type, as indicated in Table GW-4-A:

> **"Due to the fact that this alternative utilizes in situ treatment technologies that are less developed...and more sensitive to the site-specific hydrogeology and groundwater geochemistry, pre-design investigations would be performed...to verify its effectiveness."**

This treatability testing should have been performed beforehand to support the Feasibility Study and certainly should be performed before the Record of Decision. Had treatability testing been performed in advance, it would have become evident that the organic matter associated with or derived from the waste animal hides buried within the West Hide Pile are a readily degradable organic material that will consume a majority of any injected oxygen. This large oxygen sink will not only require the injection of oxygen at quantities several orders of magnitude greater than would be required in a normal aquifer, but will also impede the migration of oxygen-enriched groundwater away from the point of oxygen injection by consuming the oxygen rapidly. As a result, further reductions in the concentration of benzene in West Hide Pile groundwater will likely require the injection of oxygen in quantities designed to cause the complete degradation of the soluble organic carbon from the hides. Consequently, enhanced *in-situ* bioremediation cannot feasibly be implemented to treat benzene in groundwater at the West Hide Pile as proposed in USEPA's Proposed Plan is technically infeasible.

6.4 References

Tetra Tech NUS, Inc., 2005. Draft Final Feasibility Study, Remedial Investigation/Feasibility Study, Industri-Plex Site, Woburn, Massachusetts.

Roux Associates, Inc., Environmental Science and Engineering, Inc., and PTI Environmental Services, 1991. Ground-Water/Surface Water Investigation Plan Phase 1 Remedial Investigation Final Report.

Roux Associates, Inc., Environmental Science and Engineering, Inc., and PTI Environmental Services, 1992. Ground-Water/Surface-Water Investigation Plan, Phase 2 Remedial Investigation Draft Report.

Roux Associates, Inc., 2003. Letter Report to Mr. D. Michael Light, Industri-Plex Site Remedial Trust, Re: Final GSIP Scope of Work Source Area Investigation.

7.0 Comments on USEPA's Proposed Plan for Monitoring

Based on Roux Associates' review of the Proposed Plan and the Administrative Record documentation, we have concluded that USEPA's approach for long-term monitoring of the effectiveness and protectiveness of their Proposed Plan is seriously flawed and should not be adopted in its current form. This conclusion is based on the following two considerations:

- **During the feasibility study process, long-term monitoring evolved from a multi-medium approach to a medium-specific approach that is contrary to the USEPA's own Conceptual Site Model approach and framework for monitoring plan development, and is not integrated to the extent warranted by the interdependent nature of the preferred remedial alternatives; and**
- **This medium-specific approach results in an inappropriately extensive sampling program.**

7.1 Long-Term Monitoring Approach

In Sections 3.2 through 3.5 of the Draft Final Feasibility Study Report (Development of Remedial Alternatives), multi-medium monitoring is initially identified as an element of several of the preferred remedial alternatives. For example, at this stage of the Feasibility Study process, Alternative GW-2 included "long-term monitoring of groundwater, surface water, and sediments" (page 3-14); likewise, Sediment Alternative 5 (later termed Alternative HBHA-4) included "periodic surface water and sediment monitoring...as well as periodic groundwater monitoring" (page 3-33). Inclusion of multi-medium monitoring as an integral part of these remedial alternatives was appropriate, considering both the USEPA's own Conceptual Site Model:

- **Arsenic and benzene plumes in groundwater beneath various portions of the Industri-plex Site;**
- **Plumes migrating to and converging and commingling at the north end of HBHA Pond;**
- **Discharge of the arsenic and bezene plumes into HBHA Pond; and**
- **Arsenic and benzene largely sequestered and attenuated in HBHA Pond.**

Multi-medium monitoring is also appropriate because of the interdependent nature of many of the remedial alternatives being evaluated (e.g., the reliance of Alternative GW-2 on Alternative HBHA-4).

However, contrary to the USEPA's own framework for monitoring plan development, this integrated, multi-medium approach was not carried into the Detailed Analysis portion of the Feasibility Study process, as evidenced by the ultimate specification of medium-specific monitoring plans throughout the tables provided in Appendix B of the Draft Final Feasibility Study Report (i.e., long-term groundwater monitoring was placed in Alternative GW-2, surface water monitoring in the Surface Water Remedy, and sediment monitoring in the Sediment Remedy.) As a result, instead of a long-term monitoring program designed to test and monitor the Conceptual Site Model hypothesis of sequestration and attenuation of Site-related constituents in the HBHA Pond—where, not coincidentally, the bulk of the capital costs of the remedy are proposed to be expended—the Proposed Plan includes non-integrated monitoring of an apparently site-wide network of 15 to 20 monitoring well clusters (45 to 60 wells), another 15 wells in the former Lake Mishawum area, 20 sediment-sampling locations throughout the HBHA Pond, and 10 surface-water sampling locations along the length of the Aberjona River.

7.2 Long-Term Monitoring Objectives

The objective of long-term monitoring for the Site is to monitor the effectiveness and protectiveness of the proposed remedial actions. However, due to the non-integrated nature of the long-term monitoring program proposed by USEPA, most of the data generated can not be used to meet this objective. For example, groundwater and surface water data will be developed for many areas of the Site where changes in contaminant concentrations will have little or no impact on the effectiveness or protectiveness of the proposed remedial actions, since there are no current risks in these areas and potential future risks will be managed by institutional controls. Also, some of the analytical parameters (e.g., semivolatile organic compounds) are proposed for media and locations where they don't exist or where their presence has little or no effect on overall Site risks. Lastly, sampling frequencies proposed in the various medium-specific long-term monitoring plans, which range from quarterly to semi-annually, are also inappropriate. Typically, quarterly or semi-annual sampling is performed to identify seasonal trends, such as fluctuations in contaminant concentrations associated with higher or lower water levels. However, seasonal monitoring is clearly not needed for the duration of long-term monitoring.

7.3 References

Tetra Tech NUS, Inc., 2005. Draft Final Feasibility Study, Remedial Investigation/Feasibility Study, Industri-Plex Site, Woburn, Massachusetts.

U.S. Environmental Protection Agency, 2004. Guidance for Monitoring at Hazardous Waste Sites: Framework for Monitoring Plan Development and Implementation. OSWER Directive No. 9355.4-28.

Table 1
Sediment Arsenic Concentrations and Toxicity Data
Industri-Plex Site
Woburn, Massachusetts

Sed Sample	Location	Location Type	Arsenic mg/kg	As:Fe	Amphipod 10 day Survival (Mean %)	Amphipod 10 day Growth (Mean Weight, mg)	Amphipod 28 day Chronic Survival (Mean %)	Amphipod 42 day Chronic Survival (Mean %)	Amphipod 28 day Chronic Growth (Mean Weight, mg)
SD-MC-12	Halls Brook	Reference Site	22.8	0.00128	94	0.078	92	83	0.277
SD-MC-01	Aberjona River	Reference Site	27.8	0.00143	98	0.138	92	90	0.395
SD-MC-02	South Pond	Reference Site	29.9	0.00117	99	0.129	99	99	0.37
SD-MC-03	Phillips Pond	Reference Site	34.4	0.00124	95	0.088	99	95	0.471
SD-MC-04	Halls Brook	Reference Site	44.5	0.000862	98	0.077	93	93	0.356
SD-MC-06	HBHA Pond	Site-shallow	273	0.00689	94	0.04	60	59	0.159
SD-MC-13	Aberjona River	Site-shallow	339	0.00616	96	0.077	76	73	0.26
SD-MC-08 (ave)	HBHA Pond	Site-shallow	594	0.0054	94	0.02	88	89	0.259
SD-MC-10	HBHA Wetland	Site-shallow	639	0.00674	95	0.132	96	91	0.32
SD-MC-09	HBHA Wetland	Site-shallow	802	0.00723	90	0.056	92	84	0.291
SD-MC-05	HBHA Pond	Site-deep	1103	0.0154	0	0			
SD-MC-11	HBHA Wetland	Site-shallow	1200	0.00870	95	0.137	79	81	0.233
SD-MC-07	HBHA Pond	Site-deep	2390	0.0206	36	0.02			

Samples that demonstrated toxicity in 10 days were not carried through chronic toxicity testing.

Table 1
Sediment Arsenic Concentrations and Toxicity Data
Industri-Plex Site
Woburn, Massachusetts

Sed Sample	Amphipod Chronic Reproduction (Mean Number of Neonates/Female)	Chironomid Acute Survival (Mean %)	Chironomid Acute Growth (Mean Weight, mg)	Chironomid Chronic Survival (Mean %)	Chironomid Chronic Growth (Mean Weight, mg)	Chironomid Chronic Emergence (Mean %)	Chironomid Chronic Reproductive Effects (Mean Days Survived, Male)
SD-MC-12	2.8	94	1.836	60	3.027	50	2.6
SD-MC-01	8.9	95	1.36	50	2.838	53	4.9
SD-MC-02	4.3	88	1.629	27	3.459	42	4
SD-MC-03	7.9	98	1.995	46	3.069	55	1.7
SD-MC-04	4.4	99	1.358	38	2.968	45	4.6
SD-MC-06	0.5	94	0.959	19	0.946	18	2.1
SD-MC-13	1.9	84	1.585	65	2.278	30	1.7
SD-MC-08 (ave)	2.5	95	0.997	65	2.578	51	2.7
SD-MC-10	3.3	88	1.596	19	1.213	41	4.1
SD-MC-09	2.4	94	1.076	44	5.619	39	2.8
SD-MC-05		4.5	0.084				
SD-MC-11	1	96	1.292	17	3.933	14	3.6
SD-MC-07		49	0.169				

Samples that demonstrated toxicity in 10 days were not carried through chronic toxicity testing.

FIGURE 1
Scatterplot of Sediment Arsenic Concentration and Amphipod Survival

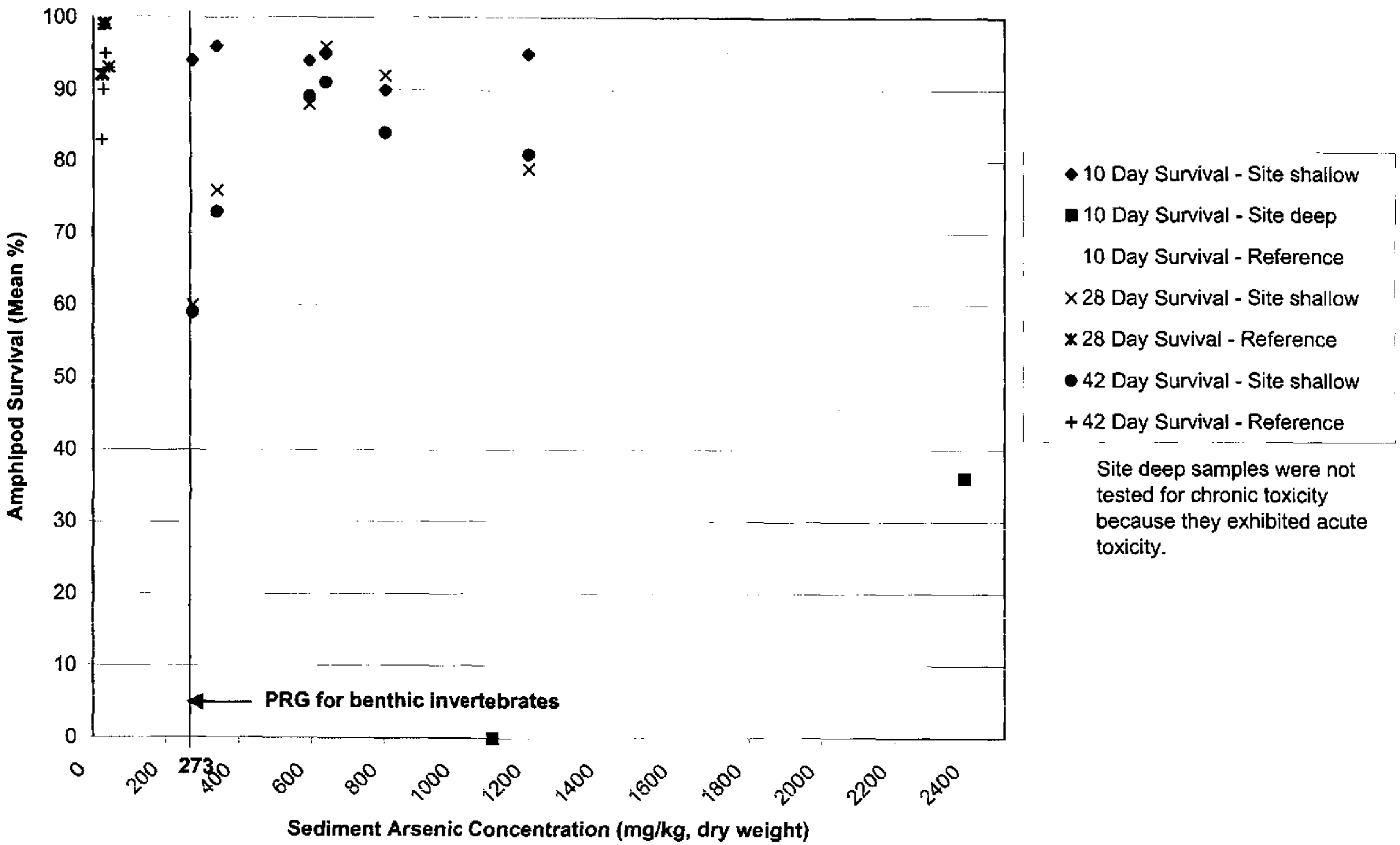


FIGURE 2
Scatterplot of Sediment Arsenic Concentration and Amphipod Growth

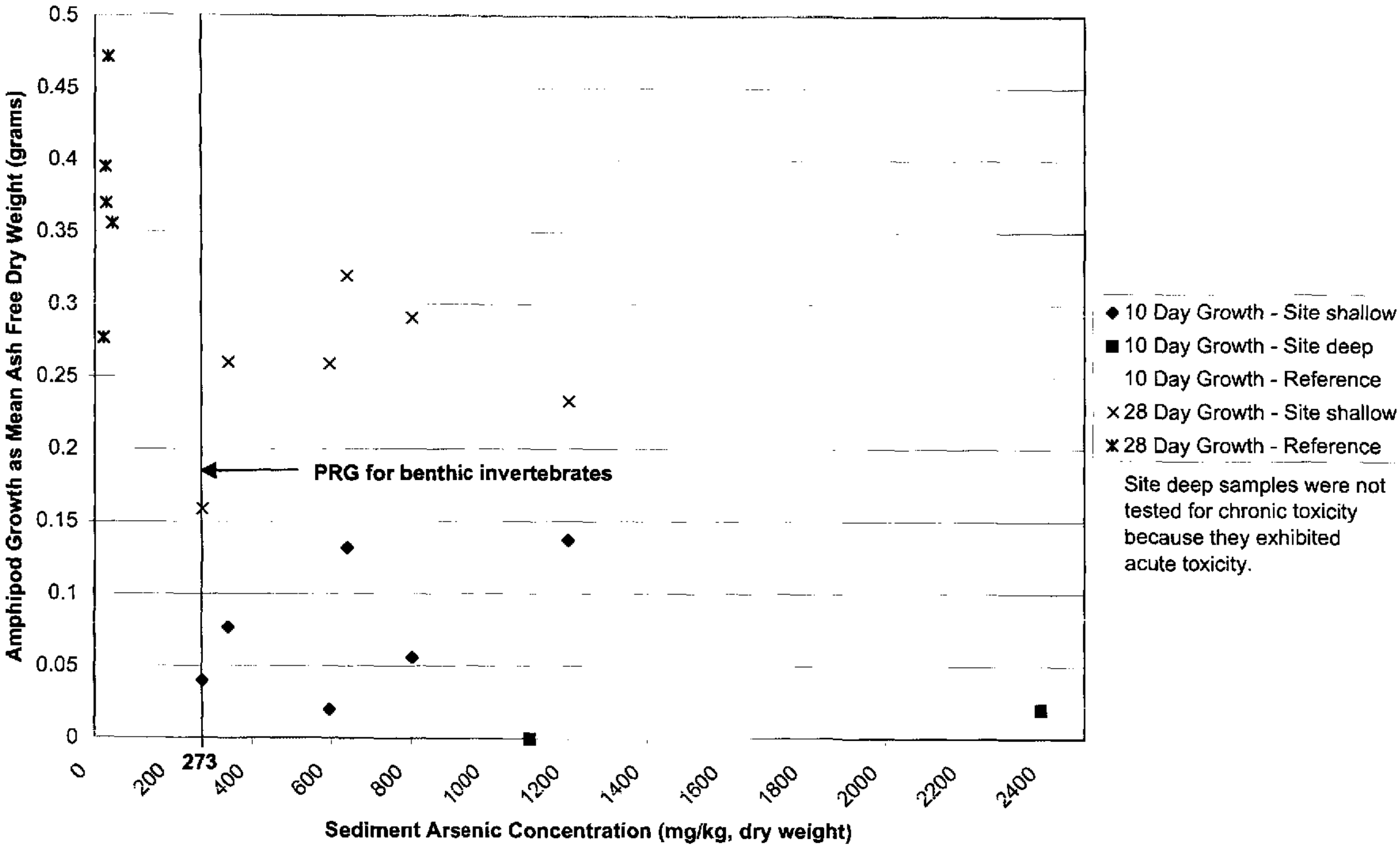


FIGURE 3
Scatterplot of Sediment Arsenic Concentration and Midge Survival

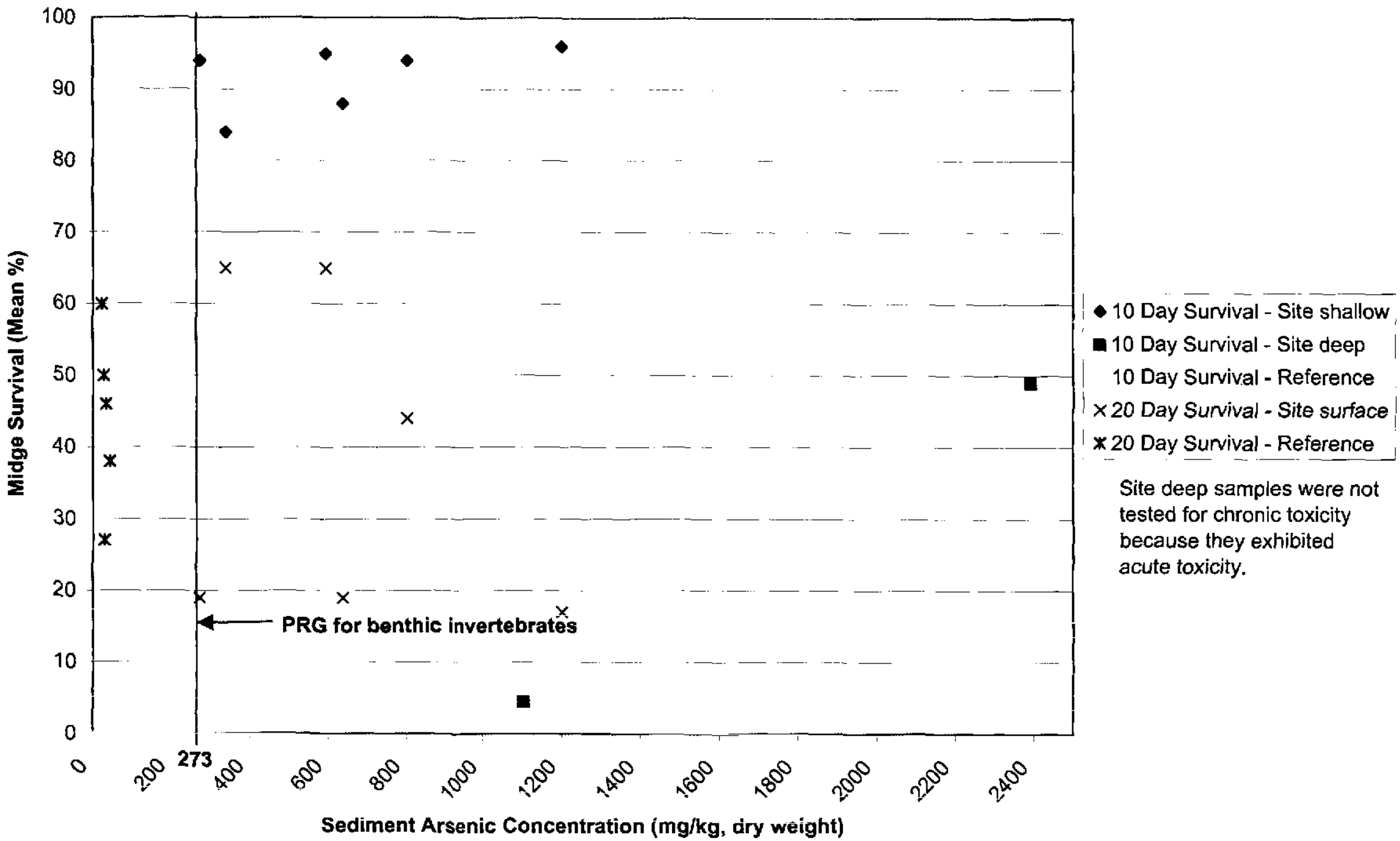


FIGURE 4
Scatterplot of Sediment Arsenic Concentration and Midge Growth

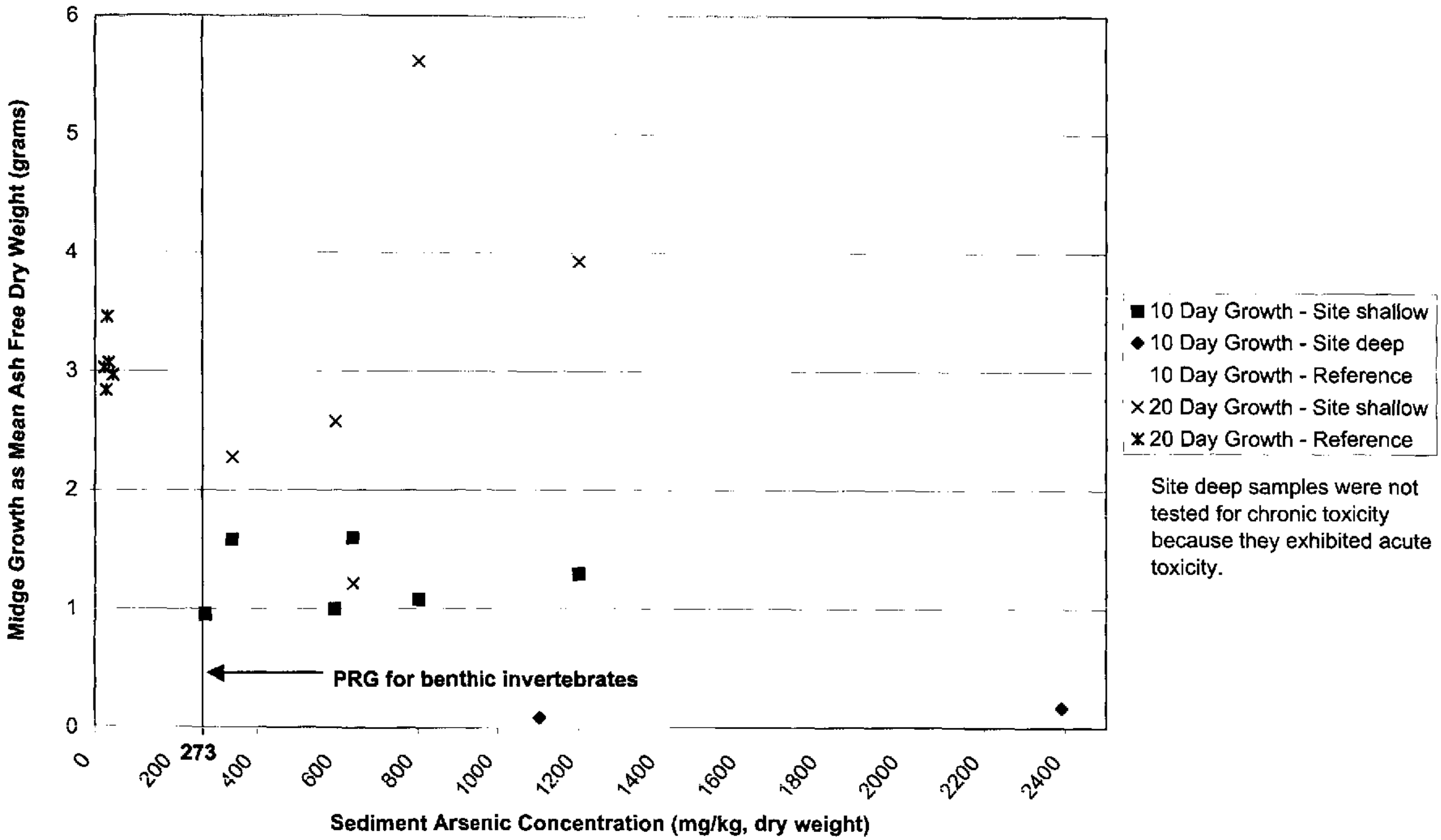
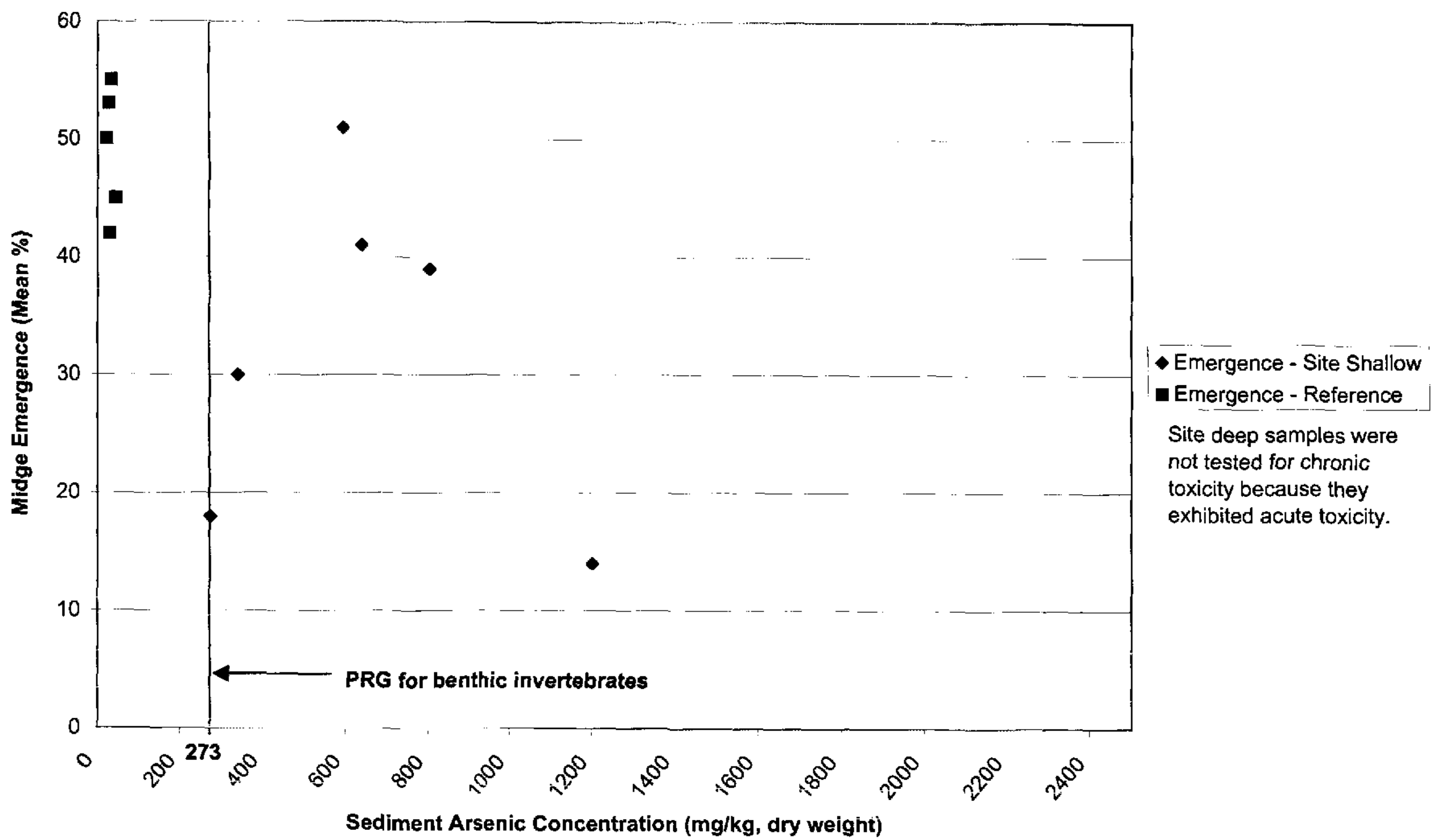
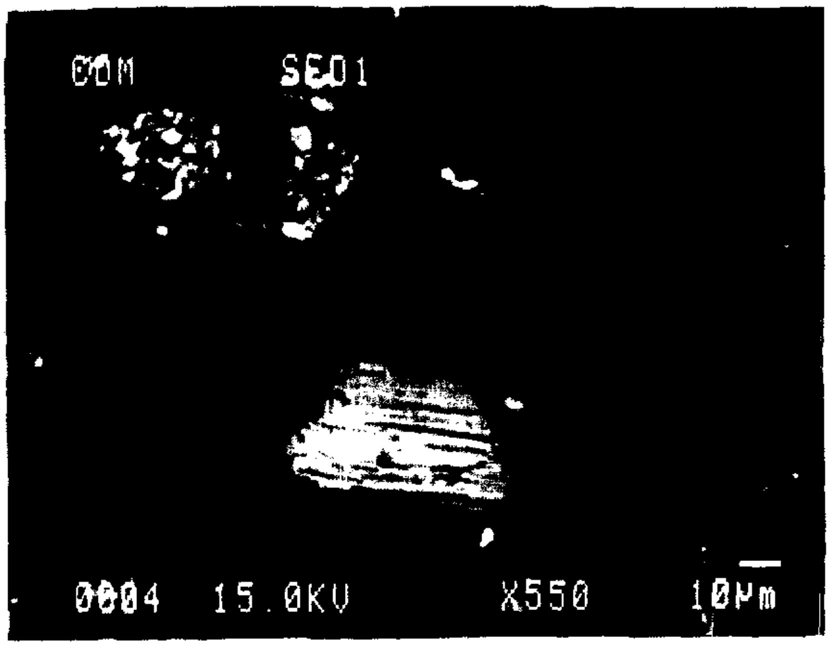
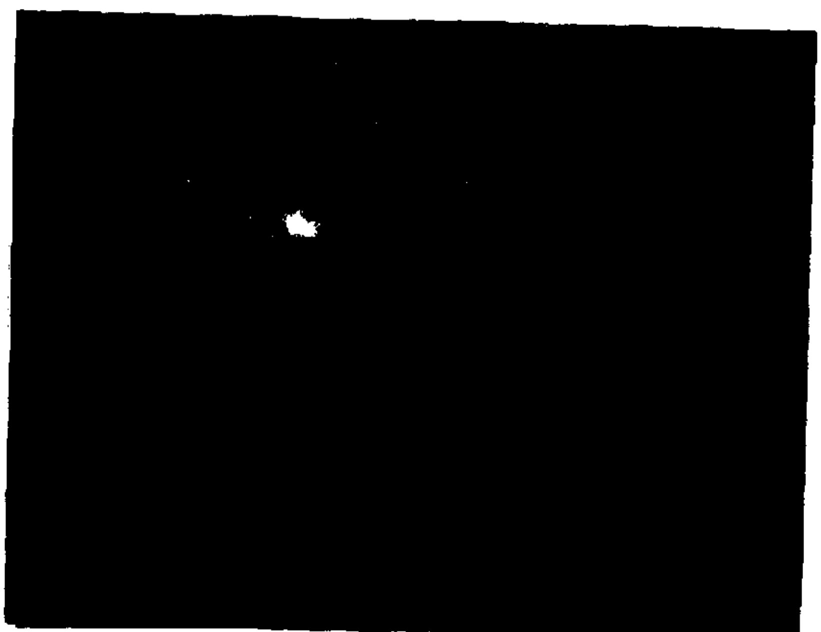


FIGURE 5
Scatterplot of Sediment Arsenic Concentration and Midge Emergence

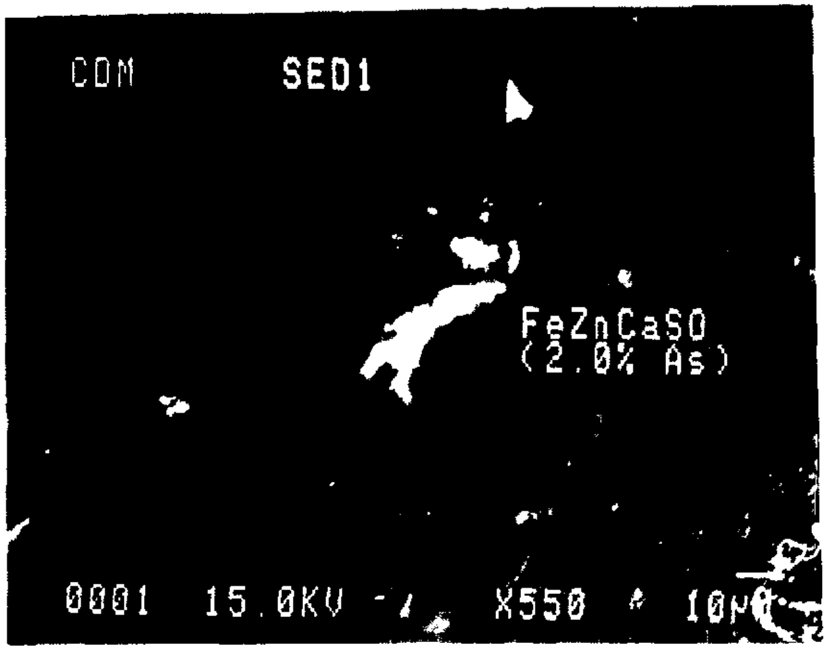




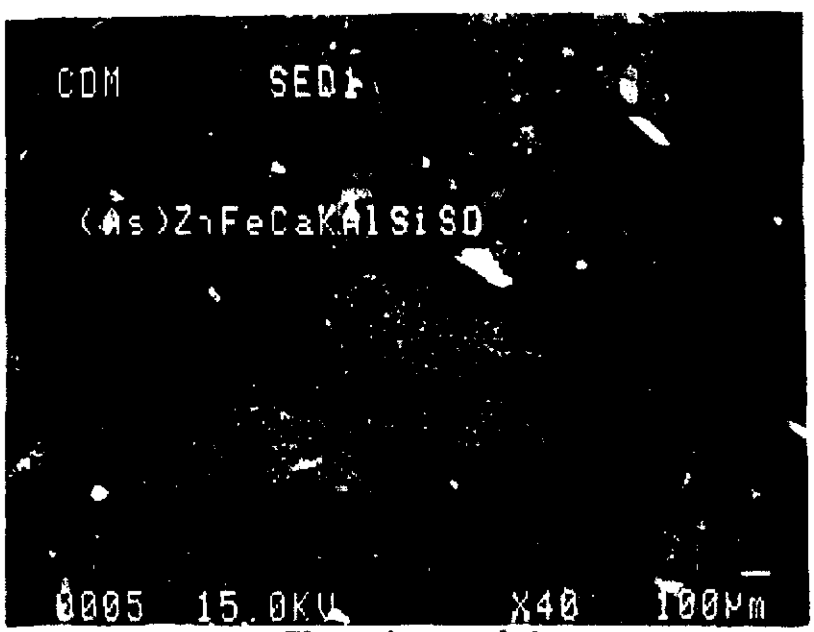
Photomicrograph 1
SED 1
Backscatter image showing a particle of iron/aluminum sulfate containing 6.4% arsenic and two grains of biotite containing approximately 0.2% arsenic.



Photomicrograph 2
SED 1
Arsenic concentration map (Dot map) showing the same frame as in photomicrograph 1. Note the higher density of dots on the iron/aluminum sulfate and biotite grains.



Photomicrograph 3
SED 1
Backscatter image showing a grain of iron/calcium/zinc sulfate containing 2% arsenic.



Photomicrograph 4
SED 1
Backscatter image showing a mass of alumino silicate and quartz grains cemented by an arsenic - bearing iron/calcium/zinc sulfate.

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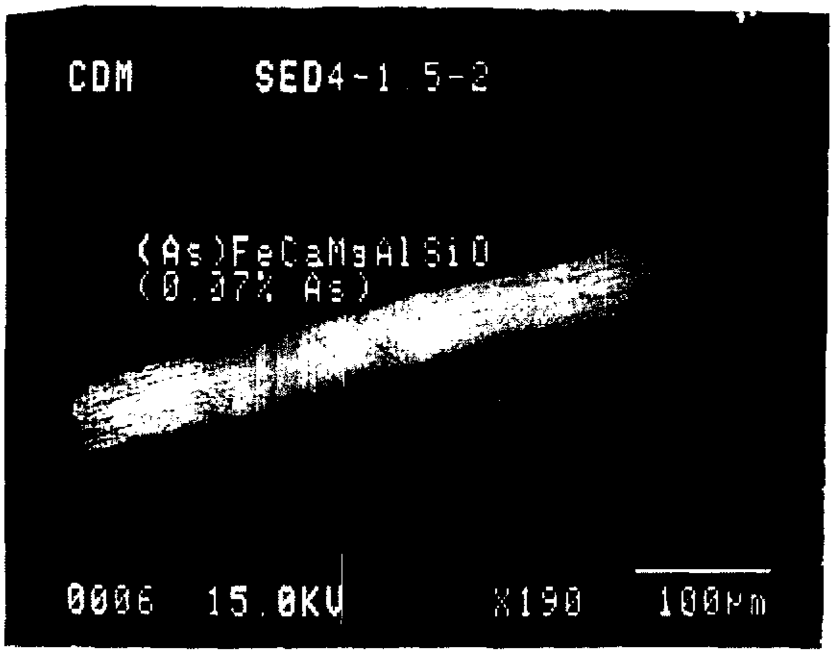
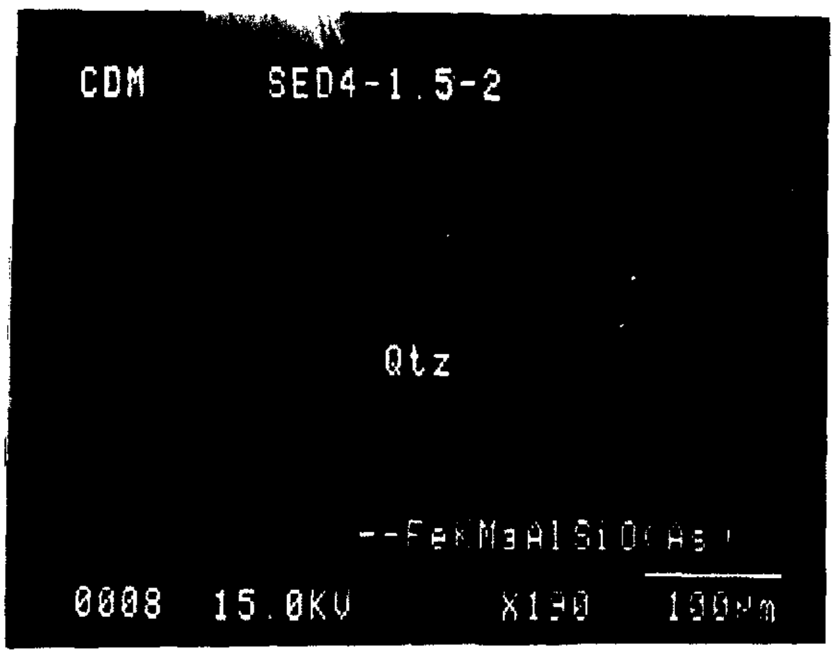
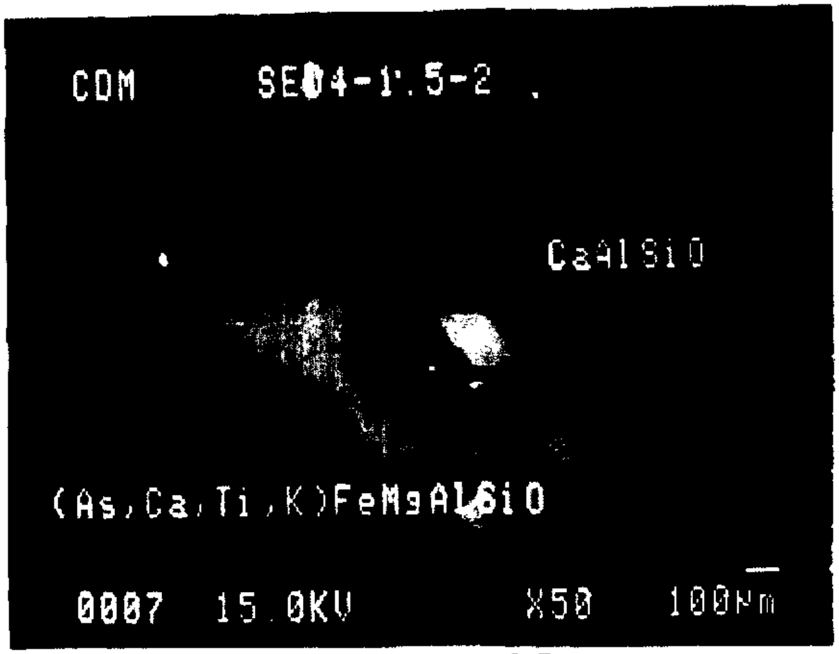


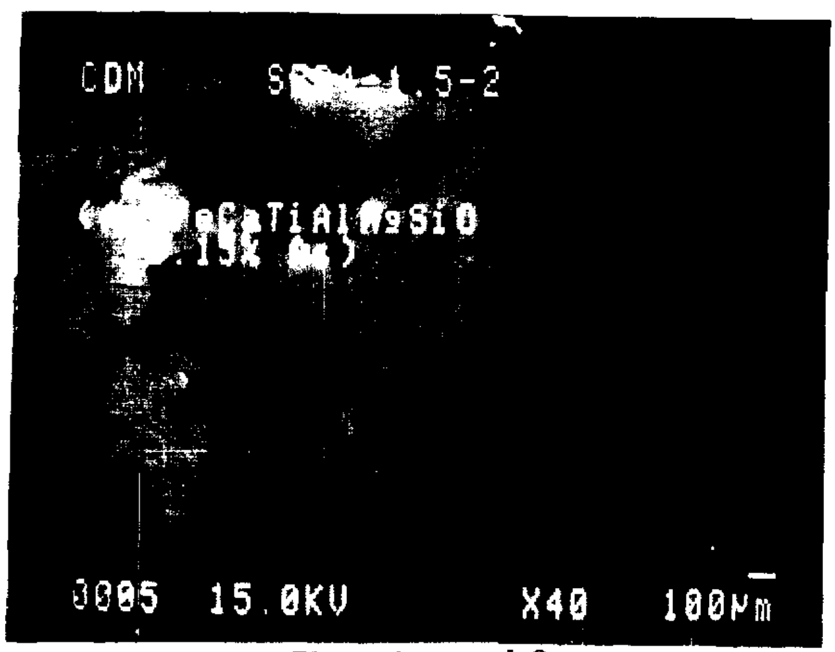
Photomicrograph 5
SED 4
Backscatter image showing a biotite or clay grain containing 0.07% arsenic.



Photomicrograph 6
SED 4
Backscatter image showing arsenic bearing biotite grains intergrown with quartz.



Photomicrograph 7
SED 4
Backscatter image showing an arsenic-bearing biotite grain



Photomicrograph 8
SED 4
Backscatter image showing an amphibole or pyroxene grain containing 0.15% arsenic.

Photomicrograph 9
SED 4
Backscatter image showing an arsenic - bearing silicate mineral.

Lisa JN Bradley, PhD, DABT

Years Experience: 22

Technical Specialties

- Mechanisms of Carcinogenesis and Mutagenesis
- Risk Assessment

Professional History

- ENSR Consulting and Engineering
- Massachusetts Institute of Technology
- University of Idaho

Education

- PhD (Toxicology) Massachusetts Institute of Technology, 1991
- BS (Zoology) University of Idaho, 1983
- BS (Chemistry) University of Idaho, 1983

Professional Registrations and Affiliations

- Diplomate, American Board of Toxicology, 1994
- Society of Toxicology
- Society for Risk Analysis
- Phi Beta Kappa
- Regulatory Toxicology and Pharmacology

Representative Project Experience

A. Representative Superfund Experience

Pines Area of Investigation, Indiana. Serving as project manager for the Remedial Investigation/Feasibility Study for the Respondents of an Administrative Order on Consent (AOC) being administered as a Superfund-like site under the USEPA Region 5 Superfund program. The AOC addresses the placement of coal combustion by-products (CCBs) within a local permitted landfill and allegedly used as fill in other locations within the Area of investigation. Activities to date include agency negotiations on the AOC and scope of work; submittal and subsequent approval of a Site Management Strategy document, the RI/FS Work Plan (including a Field Sampling Plan, Human Health and Ecological Risk Assessment Work Plans, HASP, QAPP, and a Quality Management Plan), and additional Sampling and Analysis Plans; and communications activities (including a website and regular mailings of information updates to the community).

Delaware Sand & Gravel Remedial Trust, Delaware. Providing risk assessemnt support to the Trust in their review of an operating remedial system.

Solutia, Inc., Human Health Risk Assessment, Illinois. Prepared a human health risk assessment workplan to follow Superfund guidelines for several abandoned landfill areas and areas downgradient of the landfills. The workplan was accepted by U.S. EPA Region V. A comprehensive human health risk assessment was prepared that evaluated the former land fill areas as well as local residential areas, a creek, and a borrow pit lake. A total of 64 receptor and area scenarios were quantitatively evaluated. Supporting risk modeling included indoor and outdoor air from subsurface soil and groundwater. Activities included site visits, meetings with personnel from USEPA Region 5 and their contractors, and preparations of responses to comments and document revisions. The human health risk assessment has been accepted by the agency, and the results are being used to guide the feasibility study and remedy selection.

Sauget Area 2 Sites Group, Human Health Risk Assessment, Illinois. Prepared a human health risk assessment workplan to follow Superfund guidelines for a set of sites that include abandoned landfill areas. Activities included a site visit, meetings with USEPA Region 5 and their contractors, and preparation of responses to comments. Conducting the multireceptor, multi-pathway human health risk assessment, including vapor intrusion modeling for both indoor and outdoor air.

Admiral Home Appliances, Human Health Risk Assessment, South Carolina. Prepared a human health risk assessment workplan following U.S. EPA Region 4 guidance for a site being evaluated under Superfund guidelines.

Columbia Gas Transmission, Strategic Risk Assessment Advisor, West Virginia. Serving as strategic risk assessment advisor to a multi-site, ten-state AOC with U.S. EPA Region III. Responsibilities include review of other contractor reports, development of a common strategy for TPH and mercury to be used in the program, review and summary of risk assessment regulations and guidance for each of the states (Ohio, Pennsylvania, West Virginia, Virginia, Kentucky, North Carolina, Delaware, New Jersey, Maryland, New York, and Louisiana), and conduct risk assessments.

Tippecanoe Landfill, Human Health Risk Assessment, Indiana. Conducted agency negotiations (U.S. EPA Region V) concerning the human health risk assessment for a Superfund site. Because arsenic concentrations in groundwater were of concern to the agency, researched and reviewed the toxicological information available for arsenic, and prepared a literature review and critique of the current dose-response values developed by the U.S. EPA for arsenic.

Industri-Plex CERCLA Site, Risk Assessment Review and Strategy for PRP Group, Massachusetts. Providing risk assessment review and strategy for PRP group, and developed risk assessment workplan to address surface water and groundwater exposure pathways. Providing comments on the Agency's RI/FS document and Proposed Plan including a human health risk assessment.

Manufacturer, Human Health Risk Assessment, South Carolina. Conducted the human health risk assessment under the purview of USEPA Region IV, for a CERCLA site that was a former manufacturing facility. Employed both the child and adult lead models to evaluate remedial goal options. Incorporated fate and transport modeling to evaluate future groundwater and surface water exposure pathways.

Tennessee Valley Authority, Human Health Risk Assessment, Tennessee. Prepared human health risk assessment and developed target cleanup levels for an abandoned battery manufacturing site. Primary constituent was lead and both child and adult lead models were used in the evaluation.

Confidential Client, Human Health Risk Assessment, New Jersey. Conducted a human health risk assessment for a school district's baseball fields located adjacent to a potential Superfund site. Report was prepared for community distribution, and results presented at a public meeting.

Confidential Client, Human Health Risk Assessment, New Jersey. Conducted a preliminary human health risk and ecological assessment for a site being considered for inclusion on the NPL using data available for the site. The preliminary risk assessment formed the basis of a Work Plan for the site, was used to identify areas of uncertainty that could benefit from further research, and included evaluation of local state biological water quality criteria.

Old Southington Landfill, Human Health Risk Assessment, Connecticut. Managed and conducted a human health risk assessment for a Superfund site. The site was a former landfill that is currently used for both residential and industrial purposes. Project included meetings and negotiations with U.S. EPA Region I.

Motco Superfund Site, Review of AIC for Volatile Organics, Texas. Reviewed U.S. EPA-developed acute inhalation criteria (AIC) for volatile organics. Developed a consistent and scientifically-defensible methodology for AIC development, and applied this methodology to provide alternative AICs for use at the site.

Brio Site Task Force, Texas. Developed acute inhalation criteria for use in a remedial program for benzene, 1,1-dichloroethane, 1,2-dichloroethane, ethyl benzene, methylene chloride, styrene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, and vinyl chloride.

A. Representative RCRA Experience

Solutia, Inc., Human Health Risk Assessment Oversight for the J.F. Queeny Facility, St. Louis, Missouri. Providing oversite for the human health risk assessment being prepared for the facility under an order with USEPA Region 5. The risk assessment is designed to meet the requirements of both USEPA and the State of Missouri Risk-Based Corrective Action Program.

Solutia, Inc., Human Health Risk Assessment Workplan for the W.G. Krummrich Facility, Sauget, Illinois. Developed the human health risk assessment workplan of the RCRA Sampling Plan for Solutia's W.G. Krummrich Facility. The workplan was designed to permit evaluation of the "Human Exposures Environmental Indicator" as well as human health risk.

Solutia, Inc., Human Health Environmental Indicator Risk Assessment Workplan for the Flexsys America, L.P. Facility, Nitro, West Virginia. Developed the human health risk assessment workplan to address the RCRA Human Health Environmental Indicator (CA725) for the facility. The workplan was designed to permit evaluation of the "Human Exposures Environmental Indicator" as well as human health risk.

U.S. Steel, Human Health Risk Assessment, Gary, Indiana. Developed the RCRA RFI Human Health Risk Assessment Workplan for the U.S. Steel Gary Works. Activities have included response to regulatory comments on previous reports, site visits, review of reports generated both by USS and by local groups about the facility and its environs, development of the risk-related portions of the facility-wide RCRA RFI workplan, in addition to the HHRA workplan, and agency negotiation.

U.S. Steel, Human Health Risk Assessment, Gary, Indiana. Participated in strategy development for and preparation of the human health sections of the Sampling and Analysis Plans for each of the Solid Waste Management Areas being addressed at Gary Works under RCRA (13 in total).

U.S. Steel, Human Health Risk Assessment, Gary, Indiana. Managed and prepared the human health risk evaluation of perimeter groundwater data. Work included conducting a two tiered well-by-well screening (55 wells total). The first tier comparison was to generic and readily available standards, and the second tier took into account background and dilution into receiving water bodies, and evaluated construction worker and indoor air scenarios.

U.S. Steel, Human Health Risk Assessment, Fairless Hills, Pennsylvania. Prepared the human health risk evaluation under RCRA Corrective Action for a parcel of property to be leased by U.S. Steel at Fairless Works. The work was conducted to satisfy Pennsylvania Department of Environmental Protection (PADEP) requirements under the Pennsylvania Act 2 program, as well as USEPA Region 3 requirements. Activities included site visit, meetings and presentations to both agencies, as well as preparation of memoranda and reports. Included in the evaluation was a sensitivity analysis of the parameters used to evaluate a construction worker scenario; site-specific parameters, parameters from the scientific literature, and parameters provided by the agency were evaluated. Currently developing a site-wide approach to risk assessment to satisfy both Act 2 and Region 3 requirements.

U.S. Steel, Human Health Risk Assessment, Fairfield, Alabama. Developed the RCRA RFI Human Health Risk Assessment Workplan for the U.S. Steel Fairfield Works under USEPA Region 4 and Alabama Department of Environmental Management (ADEM) requirements. Activities included site visits, preparation of strategy, review of the full RFI workplan to ensure consistency with risk objectives, and preparation of responses to agency comments. Work included a detailed evaluation of USEPA's current and proposed adult soil ingestion rates.

Alside, Human Health Risk Assessment, Cuyahoga Falls, Ohio. Prepared a work plan and human health risk assessment report for a facility as part of a RCRA Facility Investigation under U.S. EPA Region V. Constituents of interest included metals in soils and groundwater.

Gold Mills, Human Health Risk Assessment, Pine Grove, Pennsylvania. Prepared the human health risk assessment for the RCRA Facility Investigation Report under U.S. EPA Region III. Constituents of interest included chlorinated solvents. Fate and transport models were used to evaluate movement within groundwater and to evaluate vapor transport of constituents from groundwater to indoor air as well as vaporization of constituents from groundwater used as process water.

Con Edison, Human Health Risk Assessment, New York. Conducted a human health risk assessment for a portion of the Con Edison Astoria facility under a state-led RCRA program. Constituents of interest included PCBs and metals. Remaining areas of the facility will be addressed once the investigatory data are available.

Sun Oil Company, Health Assessment of RCRA Facility, Philadelphia, Pennsylvania. Prepared the Health Assessment of the RCRA Facility Investigation for Sun's Philadelphia Refinery. Developed Action Levels for the chemicals of concern in each solid waste management unit. In addition, prepared and presented in the RFI preliminary Media Cleanup Standards for each unit.

Pulp and Paper Industry Client, Human Health Risk Assessment, USEPA Region III. Prepared a human health risk assessment for a process ditch at a facility undergoing state-led corrective action. The facility had been prepared to spend upwards of a million dollars under capital projects to address the ditch, but the results of the risk assessment indicated that the expenditure was not warranted on a health risk basis.

Solar Turbines, Inc., Human Health Risk Assessment, California. Conducted a human health risk assessment as a component of the closure of seven hazardous waste management units and RCRA Corrective Action as administered by the State of California.

C. Representative Risk Assessment Experience Under Other Programs

Bureau of Land Management, Environmental Impact Statement, Western States. Developing human health risk assessment to evaluate five pesticides proposed for use in BLM vegetation treatment programs. Risk assessment uses standard USEPA Office of Pesticide Policy risk assessment methods and includes use of the AgDRIFT model to evaluate off-site spray drift and deposition, and transport models to evaluate surface water impacts. Worker, public and Native American subsistance receptors are evaluated. Work has included interagency scoping meetings.

Confidential Client, Indiana. Evaluated groundwater and soil gas data for vapor intrusive to indoor air using the USEPA version of the Johnson and Ettinger model. Used the Johnson (2002) sensitivity analysis method to ensure that critical model parameters were within acceptable/realistic ranges. Provided deposition testimony and testimony in a court hearing on both the vapor intrusion pathway risk assessment and the toxicology of benzene.

U.S. Steel, Development of a Standardized Risk Evaluation Guidance Manual, Pennsylvania. Worked in conjunction with another firm and USS personnel to develop a standardized Risk Evaluation Guidance Manual for USS. The manual addresses important issues in human health and ecological risk assessment, provides background for the issues, USS strategy to address the issues, and examples of standard language and references to be used in future USS reports. The manual will allow for more cost-effective and consistent risk evaluations to be conducted for USS facilities and sites.

U.S. Steel, Review and Comment on Indiana's RISC Program, Indiana. Reviewed several draft versions of Indiana's "Risk Integrated System for Closure" guidance, and submitted comments to the agency. Detailed comments were provided on the following topics: construction worker soil ingestion rate, soil saturation limit, arbitrary caps for metals concentrations in soil. Have also prepared comments on Indiana's draft groundwater policy and The User's Guide that details how the RISC program will be applied to RCRA sites under state authority.

U.S. Steel, Human Health Risk Assessment, Fairfield, Alabama. Conducted a human health risk evaluation for a parcel of property to be leased by U.S. Steel at Fairfield Works. Activities included evaluation of a construction worker scenario, and use of the Johnson & Ettinger and ASTM models to evaluate indoor and outdoor air.

Moen, Human Health Risk Assessment, Pennsylvania. Conducted a human health risk assessment in support of a remedial action alternatives evaluation. Work was conducted to be consistent with the Pennsylvania Act 2 environmental program. Of interest were chlorinated solvents in groundwater. Target levels for constituents of interest were developed for surface water based upon reasonable exposure scenarios. The target levels will be used to determine the efficacy of on-going remedial actions.

Confidential Railroad Client, Evaluation of Data, Pennsylvania. Conducted detailed evaluation of data collected from a rail yard consistent with the Pennsylvania Act 2 environmental program. Oversaw the development of a database of the Act 2 standards to be used for facile screening of large amounts of data. Prepared report summarizing the results.

Latham and Watkins, Litigation Support, Los Angeles, California. Provided litigation support in a trial over a property's value and environmental liabilities. Conducted risk screening evaluation of available site data, and provided support to lawyers taking deposition of opposing risk assessor/toxicologist.

Confidential Client, Risk Assessment Support, Pennsylvania. Provided risk assessment support during year-long negotiations with regulatory agency covering multiple sites within the state. Developed risk-based action level for diesel fuel TPH based on direct contact and soil-to-groundwater pathways.

Bridgestone/Firestone, Development of Risk-Based Cleanup Levels for TPH and Lead in Soils, Texas. Developed risk-based cleanup levels for TPH and lead in soils based on the protection of underlying groundwater quality under the TNRCC Leaking Storage Tank Program. TNRCC's approval allowed for the timely remediation of the site for subsequent sale.

Con Edison, Risk Assessment Project, New York. Conducted the risk assessment project associated with Con Edison's Spill Remediation Program, a part of the Order on Consent with NYSDEC. Developing a risk-based concentrations (RBC) for the spill materials included in the program based on a matrix of potential spill location exposure scenarios. Both direct contact and groundwater pathway exposures are addressed in the program. ENSR developed a screening procedure to be used in conjunction with the RBC to enable Con Edison to address and close spill sites in both a cost-effective and health-protective manner. There is ongoing interaction with NYSDEC Spills Program and headquarters personnel in the project.

Stanley Structures, Plan B Exposure and Risk Assessment, Texas. Performed a Plan B Exposure and Risk Assessment under the TNRCC Leaking Storage Tank Program. Results indicated that no further action was warranted for the site and allowed for closure of a real estate transaction.

Computer Manufacturing Facility, Risk Assessment for Diesel Fuel TPH in Soil, Arizona. Conducted a risk assessment for diesel fuel TPH in soil at a facility sold by the client, but for which the client maintained environmental liability. Demonstrated using literature data on the components of TPH that the site met the state's cleanup criteria for TPH and its individual components. Agency approval for site closure was obtained. This project was the first risk-based closure under the State of Arizona's Soil Remediation Standards Rule. Use of literature data on diesel composition eliminated the need for additional environmental sampling, reducing project costs. Achievement of official risk-based closure saved the client additional remedial costs and eliminated liability for the property, allowing the real estate transaction to close.

Confidential Client, Technical Review of State-Sponsored Monitoring Program, Idaho. Provided a pulp mill facility with technical review of a state-sponsored air monitoring program conducted in the vicinity of the facility. Provided information on background levels of chloroform in urban and rural areas of the U.S. to support the conclusion that the locally measured concentrations were not significantly different from those for other regions of the U.S. Informed the client and the state about new information on the toxicology of chloroform that is likely to change how chloroform is regulated by the U.S. EPA.

Confidential Client, Peer Review, Alaska. Provided peer review for a risk assessment of air emissions performed for a pulp mill in Alaska. Brought to the attention of the client the overly conservative nature of the assessment. In addition, informed the client of new information on the toxicology of chloroform that would have a direct bearing on the risk estimates for the facility. Based on this review, provided senior oversight for the revisions made to the risk assessment before its submittal to the state.

Confidential Client, Peer Review, Alaska. Provided peer review for a distributional (Monte Carlo) analysis of risk for human health risk assessment of chloroform associated with pulp mill emissions.

Arizona Department of Environmental Quality, Human Health Risk Assessment Implementation, Four Regions, Arizona. Implemented the human health risk assessment for hazardous air pollutants for the State of Arizona in response to a legislative mandate. Four regions of Arizona were chosen for study based on population and geographical characteristics. An inhalation risk assessment was performed for all four regions. Preliminary analyses indicated that a multipathway risk assessment was not warranted. The assessments were based on a detailed emissions inventory and gridded air dispersion model for each region. Risk was evaluated for current conditions as well as conditions predicted upon implementation of controls mandated by the 1990 Clean Air Amendments. The final report was submitted to the Office of the Governor.

National Oil Company, Human Health Risk Assessment, Virginia. Conducted human health risk assessment for a gasoline and fuel oil holding facility. Developed a toxicity ranking scheme for PAH that do not currently have EPA derived oral Reference Doses. Used the results of the risk assessment and ranking scheme to develop target cleanup levels for PAH in soils and groundwater.

Hazardous Waste Incinerators, Human Health Risk Assessment. Managed the multi-pathway human health risk assessment for the permitting of a proposed facility. Developed toxicological parameters for specific chemicals of concern for use in human health risk assessments for proposed facilities.

Former Industrial Plant Site, Developing Clean-up Levels for PAHs, Michigan. Developed health-based target cleanup levels for PAHs and related compounds for soils and for a perimeter air monitoring program for a tar and oil containing site. Incorporated comparative potency rankings and in situ degradation rates in the development of target cleanup levels.

National Oil Company, Human Health Risk Assessment, Massachusetts. Management of human health risk assessment for a former tank farm facility under the Massachusetts Contingency Plan. Provided critical input on proposed field sampling plans. Identified issues of potential concern at the site by analyzing risks using maximum detect data. Information was used to develop site specific assumptions to be used in the risk assessment.

Unocal Corporation, Health Risk Assessment, Rodeo, California. Health risk assessment task manager for the Unocal San Francisco Refinery Reformulated Gasoline Project. Tasks include preparation and submission to the agency of a protocol for the health risk assessment.

Litigation Support, Massachusetts. Conducted a human health risk assessment following Massachusetts guidelines for a field on which wastewater sludge from a juice manufacturing facility had been applied. Report was prepared for submittal to both parties in the suit.

Beal and Company, Human Health Risk Assessment, Massachusetts. Conducted a human health risk assessment and developed target cleanup levels for soils at a site on which a leaking underground storage tank had been previously located.

Bridgestone/Firestone, Human Health Risk Assessment, Alabama. Developed a site-specific human-health risk based target cleanup level for total petroleum hydrocarbons (TPH) in subsurface soils at a former automobile lubrication facility, based on the components of the lubricating and waste oils used at the site. Results were submitted to the State of Alabama as an alternative to the State's generic TPH target cleanup level.

Confidential Client, Michigan. Developed risk-based air concentrations for subchronic exposures to wood tar constituents for use in a remedial program.

Department of Environmental Quality, Arizona. Developed the risk assessment component of a legislatively mandated hazardous air pollutant (HAP) research plan for the ADEQ. The research plan was developed to aid in the developed of risk assessment guidance for the state's HAP program in compliance with the Clean Air Act.

SnyderGeneral, Inc., Human Health Risk Assessment, Texas. Conducted a human health risk assessment that evaluated exposures to groundwater containing chlorinated solvents for a facility in California.

Confidential Petroleum Company. Prepared a risk assessment generic standard language document, including selection of exposure scenarios and exposure parameters, for use in an in-house risk assessment system for fuel stations. The prepared document prompted users to enter site-specific data, provided example tables, and prompted user to include or delete receptor/exposure pathway text as appropriate to the specific site.

Confidential Petroleum Company, Human Health Risk Assessment, Rhode Island. Conducted a human health risk assessment for the development of target cleanup levels for an industrial facility. Results were used as litigation support. Dispute settled out of court in favor of the client.

Confidential Client, Arizona. Provided expert review of a risk assessment for submittal to the TNRCC (Texas) prepared by the seller of a parcel of land being considered for purchase by the client.

D. Representative Toxicology Experience

Utility Solid Waste Activities Group (USWAG), Washington, DC. Provided oversight of comments developed on the proposed listing of naphthalene as a carcinogen by the National Toxicology Program, and on the USEPA's childhood cancer document.

Electric Power Research Institute, California. Worked with another ENSR toxicologist to develope a critiquie of the benzo(a)pyrene toxicity value developed by the United Kingdom for their Contaminated Lands program.

Confidential Natural Gas Client, Toxicity Assessment, Ohio. Provided toxicity assessment of cleaning compounds proposed for use in the decommissioning of a natural gas pipeline laid on the bed of a reservoir that serves as the primary drinking water source for a community. Demonstrated that even should a catastrophic release of cleaning fluid and/or PCBs occur, human and ecological health would not be adversely affected and that concentrations at the drinking water intake would be much lower than health-based values or detection limits.

Confidential Client, Toxicology Review, Indiana. Provided a review of the toxicology and potential carcinogenicity of two structurally similar proprietary industrial chemicals. Used recent data on the nongenotoxic/cytotoxic mechanism of action of a class of potential carcinogens to demonstrate that a safe level for worker exposure exists.

U.S. Steel, Relative Toxicity Ranking, Pennsylvania. Conducted a relative toxicity ranking of U.S. Steel's 1996 SARA Title 3 Section 313 Toxics Release Inventory (TRI) based on available human health and ecological toxicity criteria. Report was prepared to support facility personnel field questions from the public about the TRI.

National Industrial Dry Cleaning Company, Literature Review, Texas. Analyzed the current literature on the toxicity and carcinogenicity of an important industrial chemical, tetrachloroethylene. Reviewed the findings and summarized their regulatory implications in a report to the client.

Industrial Trade Organization, Review of Toxicology Profiles. Reviewed toxicology profiles compiled for 30 compounds of concern to the industry. Reviewed the derivation of the RfD's for methanol and acetone, and proposed alternate values based on analysis of the literature.

National Oil Company, Massachusetts. Due to the provisional status of the state-derived dose-response value for methyl-tert-butyl ether, a compound of major importance at the site, performed a thorough study of the toxicity of the compound. ENSR's input into the state's review of the dose-response value had a direct impact on the state's decision to revise the dose-response value. This revision stands to greatly reduce the client's remedial costs.

U.S. Environmental Protection Agency, Literature Review. Developed a strategy for evaluating absorption data in the literature and applied it to the development of absorption adjustment factors for oral and dermal exposures to soil and water for 5 metals of concern at hazardous waste sites (arsenic, cadmium, chromium III, chromium VI, inorganic mercury, organic mercury, and nickel) based on a thorough review of the literature.

Georgia Pacific, Literature Review, Georgia. Reviewed literature and summarized the current scientific knowledge of the endogenous synthesis of halogenated compounds in humans.

Confidential Client, Literature Review, New York. Developed an oral reference dose for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) for use in a human health risk assessment for a hazardous waste incinerator, based on review of the literature and current regulatory guidance.

E. Representative MGP Experience

Natural Gas Company, Risk Assessment Advisor, Ohio. Serving as strategic risk assessment advisor to the manager of MGP sites.

Natural Gas Company, Former MGP Site Advisor, Wisconsin. Have reviewed remediation plans and fenceline monitoring plans, gave presentation at public meetings discussing the air monitoring plan, and have reviewed fenceline monitoring data for a remediation project.

Energy Company, Former MGP Site Review, Rhode Island. Provided senior review of an air monitoring program and identified where flexibility can be used in the development of fenceline air monitoring standards.

Village of Oak Park, Former MGP Site Advisor, Illinois. Have provided senior review of remediation plans, and fenceline monitoring plans, and provided air monitoring data evaluation. Have been involved in regulatory meetings, negotiations, and presentations to the Village council. Have also conducted public meetings concerning air monitoring aspects of the project.

Publications

Bradley, L.J.N., K. Sullivan, and M. Garcia. "Background Levels of Benzene in Indoor and Outdoor Air." Paper presented at the Gas Technology Institute's Natural Gas Technologies II Conference, Phoenix, Arizona. February, 2004

Bradley, L.J.N., M. Garcia, and K. Sullivan. "Background Levels of Benzene in Indoor and Outdoor Air." Poster presented at the Midwestern States Risk Assessment Symposium, Indianapolis, Indiana. August, 2004.

Bradley, L.J.N., and K.A. Sullivan. "Risk-Based Action Levels for Remediation Project Fence-Line Air Monitoring Programs." The Toxicologist. 72(S-1): 395. March, 2003

Bradley, L.J.N., and K.A. Sullivan. "Risk-Based Action Levels for Perimeter Monitoring Programs at MGP Sites." Paper presented at the October 2002 UMass Soils Conference, Amherst, MA.

Bradley, L.J.N., and M. Gerath. "Generic Risk and Fate Analysis for Mercury at Natural Gas Meters." Paper presented at the December 1998 Society for Risk Analysis Annual Meeting, Phoenix, AZ.

Bradley, L.J.N. and M. Gerath. "Generic Screening Level Fate and Transport Analysis for Mercury at Natural Gas Metering Sites." Poster presented at the October 1998 Contaminated Soils Conference, Amherst, MA.

Bradley, L.J.N., K.B. Lemieux, M.C. Garcia, A.H. Parsons, and D.E. Rabbe. "Comparison of Concentrations of Selected Metals and Organics in Fish Tissue and Sediment in the Grand River, Ohio, and the Southern Lake Erie Drainage Basin." Human and Ecological Risk Assessment 4(1):57-74 (1998).

Bradley, L.J.N. "TPH Analyses Provide Means of Direct Assessment of Diesel Releases." Paper presented at the October, 1997, Contaminated Soils Conference, Amherst, MA.

Bradley, L.J.N. "Risk Assessment of Hazardous Air Pollutants in Arizona." Paper presented at the December, 1996 Society for Risk Analysis Annual Meeting, New Orleans, LA.

Bradley, L.J.N. "Cost-Effective Use of Tiered Approaches in Risk Assessment." Paper presented at the October, 1996 Annual Conference on Contaminated Soils, Amherst, MA.

Bradley, L.J.N. "Role of Risk Assessment in Environmental Management." Invited paper presented at the West Virginia Manufacturers Association Environmental Compliance Conference, May, 1996, Charleston, WV.

Bradley, L.J.N. "New Toxicology Data for Chloroform: Implications for the Pulp and Paper Industry." Proceedings of the 1996 Environmental Conference of the Technical Association of the Pulp and Paper Industry. Vol 1, pp. 13-16 (1996).

Bradley, L.J.N. "Ingested Arsenic - Are the Taiwanese Data Appropriate for Risk Assessment in the U.S." Paper presented at the December, 1994, Society of Risk Analysis Conference, Baltimore, MD.

Bradley, L.J.N. "Background Levels of PAH in Urban Soils." Invited paper presented at the March, 1994, Contaminated Soils Conference, Long Beach, CA.

Magee, B.H., and L.J.N. Bradley. "Absorption Adjustment Factors for Use in Risk Assessment." Proceedings of the International Congress on the Health Effects of Hazardous Waste. (1994).

Bradley, L.J.N., B.H. Magee, and S.L. Allen. "Background Levels of Polycyclic Aromatic Hydrocarbons and Selected Metals in New England Urban Soils." J. Soil Contam. 3(4):349-361. (1994).

Bradley, L.J.N. "Background Levels of PAH in Urban Soils." Paper presented at the September, 1993, Contaminated Soils Conference, Amherst, MA.

Bradley, L.J.N. "Absorption Adjustment Factors for Use in Risk Assessment." Poster presented at the May, 1993, International Congress on the Health Effects of Hazardous Waste, Atlanta, GA.

Magee, B.H., L.J.N. Bradley, E.L. Butler, A. Dasinger, J. Grabowski. "Risk-Based Target Clean-Up Levels for TPH in Soils." In: Hydrocarbon Contaminated Soils. Vol. 3. pp. 303-319. edited by P.T. Kostecki and E.J. Calabrese. 1993.

Bradley, L.J.N. "Background Levels of PAH in Urban Soils." Poster presented at the December, 1992, Society of Risk Analysis Conference, San Diego, CA.

Bradley, L.J.N. "Risk-Based Target Cleanup Levels for TPH in Soils." Poster presented at the September, 1992, Hydrocarbon Contaminated Soils Conference, Amherst, MA.

Bradley, L.J.N. "Human Health Risk Assessment Workshop." Presented at the September, 1992, Hydrocarbon Contaminated Soils Conference, Amherst, MA.

Naser, L.J., A.L. Pinto, S.J. Lippard, and J.M. Essigmann. "Chemical and Biological Studies of the Major DNA Adduct of cis-Diamminedichloroplatinum(II), cis-[Pt(NH_3)$_2${d(GpG)}], Built into a Specific Site in a Viral Genome." Biochemistry 27 (1988) 4357-4367.

Naser, L.J., A.L. Pinto, S.J. Lippard, and J.M. Essigmann. "Extrachromosomal Probes with Site-Specific Modifications: Construction of Defined DNA Substrates for Repair and Mutagenesis Studies." In DNA Repair: A Laboratory Manual of Research Procedures. Vol. 3. pp. 205-217. Edited by E. Friedberg and P. Hanawalt. 1988.

Pinto, A.L., L.J. Naser, J.M. Essigmann, and S.J. Lippard. "Site-Specifically Platinated DNA, a New Probe of the Biological Activity of Platinum Anticancer Drugs." J. Am. Chem. Soc. 108 (1986) 7405-7407.

Bradley, L.J.N., K. Yarema, S.J. Lippard, and J.M. Essigmann. "Mutagenicity and Genotoxicity of the Major DNA Adduct of the Anti-tumor Drug cis-Diamminedichloroplatinum(II)." Biochemistry 32: 982-988. (1993).

KATHERINE A. FOGARTY, P.E., LSP

EDUCATION:

M.S. 1981 Civil Engineering, Parsons Laboratory, Massachusetts Institute of Technology, concentration in aquatic chemistry and environmental engineering

B.S. 1979 Chemistry, Boston College, *magna cum laude*

CONTINUING EDUCATION AND CERTIFICATION:

Licensed Site Professional, State of Massachusetts, 2004 (License Number 6645)

Professional Engineer, Massachusetts, 1992 (Registration No. 36778)

OSHA Certified Eight-Hour HAZWOPER Annual Refresher Training in Hazardous Waste Operations and Emergency Response, updated annually

OSHA Certified 40-Hours of Training in Hazardous Waste Operations and Emergency Response

OSHA Certified Asbestos Awareness Training Course (Institute for Environmental Education, Inc.), May 4, 2005

EXPERTISE:

Ms. Fogarty has extensive experience managing human health and ecological risk assessments at Superfund and state sites and RCRA facilities. She has fourteen years experience managing projects for Menzie-Cura & Associates, Inc.

Ms. Fogarty specializes in the application of risk assessment methodology to solve contamination problems in groundwater, surface water, soil, and sediment. Her background in engineering allows her to understand and bridge the special needs of risk assessment and remediation.

As an ecological risk assessor, Ms. Fogarty conducts and manages ecological risk assessments including: the development of quality assurance project plans, design and implementation of multi-media field sampling programs, development of conceptual models, application of wildlife exposure models, implementation of weight-of-evidence risk assessment approaches, preparation of final risk characterization reports and risk communication. She incorporates ecological principles in wildlife exposure models and oversees the development of modeling packages to improve the realism of exposure modeling.

Ms. Fogarty is a Registered Professional Engineer and a Licensed Site Professional in Massachusetts. She holds a B.S. in Chemistry from Boston College and a M.S. in Civil and Environmental Engineering from Massachusetts Institute of Technology.

EMPLOYMENT HISTORY:

1991-Present **Menzie-Cura & Associates, Inc**. Senior Environmental Scientist/Engineer. She has managed and/or performed ecological risk assessments at RCRA, Superfund, and state hazardous waste sites nationwide, including Manufactured Gas Plant (MGP) sites. As part of these assessments, she has modeled the fate of nutrients, metals, and synthetic organic compounds in subsurface, river, and estuarine environments. She has also managed hazardous waste site investigation under the Massachusetts Contingency Plan.

1988-1991 **GZA Geoenvironmental, Inc.** Senior Environmental Chemist/Project Manager. Designed and conducted surface water and groundwater chemistry studies on the effect of hazardous material disposal on natural water quality and aquatic ecosystems. Performed ecological risk assessments that include computer simulations of nutrient, metal, and organic chemical fate and transport in subsurface, river, and estuarine environments; developed company ecological risk assessment capabilities. Managed hazardous waste site investigations under Massachusetts General Law Chapter 21E and the Massachusetts Contingency Plan. Developed and managed environmental monitoring programs in support of soil removal and construction projects.

1984-1988 **GZA Geoenvironmental, Inc.** Staff Environmental Chemist. Performed computer simulations of environmental fate and transport of chemicals in the environment for hazardous waste site investigations. Performed laboratory analyses for volatile organic compounds. Served as field/staff chemist on numerous geohydrological site investigations.

1979 **United States Environmental Protection Agency, Region I Laboratory**. Summer Intern. Responsible for preparation of samples and preliminary sample screening by gas chromatography.

PROFESSIONAL ORGANIZATIONS:

American Geophysical Union
New England Estuarine Research Society
Society for Risk Analysis
Licensed Site Professional Association

PUBLICATIONS:

PUBLISHED PROCEEDINGS, CONFERENCES AND SYMPOSIA

R. Schuck, D. Gevalt, J. Mullen, C. Menzie, and **K. Fogarty**. 2003. Risk-based remediation of lead and Chromium Impacted Sediments in Lake Waban, Wellesley, MA: A Case Study. Second International Symposium on Contaminated Sediments. May 26-28, 2003. Quebec, Canada.

C.A. Menzie, **K. A. Fogarty**, and Kenneth M. Cerreto. Using Water Lilies to Evaluate Metals Bioavailability and Exposure. Poster Session, New England Association of Environmental Biologist Annual Conference, April 4-6, 2001.

K. A. Fogarty. Application of the Sediment Triad Approach to a Pond Receiving Industrial Discharges and Airport Runoff. Poster Session, Society for Risk Analysis New England Chapter and Boston Risk Assessment Group, Cambridge, MA, April 9, 1997.

K.A. Fogarty, C.A. Menzie, and J. Freshman. Bioaccumulation of Contaminants in Deployed and Native Bivalve Shellfish, Thames River, Connecticut. Presentation, New England Estuarine Research Society Fall Meeting, 1994.

Williams, W.G. and **K. A. Fogarty**. 1985. Evaluating cadmium solubility in landfill with mineral stability analyses. In *Proceedings of the Fifth National Symposium on Aquifer Restoration and Ground Water Monitoring*, Columbus, OH, May 21-24, by the National Water Well Association. Dublin, OH.

Examples of Dr. Olsen's recognition as an expert in the area of strategic planning is the variety of committees and projects he works on. Some of these include:

- National Research Council's Committee on Innovation in and Commercialization of Ground Water Remediation. Dr. Olsen is currently completing this 3-year appointment. He was subchairman of the section on testing and methodology for innovative systems.

- Presumptive Remedy for Metals in Soils. Dr. Olsen was selected by EPA to review and write sections of the new Presumptive Remedy for Metals in Soils. The draft of this guidance is under review.

- Protocol for Implementing Intrinsic Remediation. Dr. Olsen was one of three experts selected by EPA to review the draft document: "Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Ground Water" issued by the Air Force.

- Dr. Olsen was an Invited speaker at U.S. EPA's Workshop on Managing Arsenic Risks to the Environment: Characterization of Waste, Chemistry and Treatment and Disposal.

Dr. Olsen has also recently received awards for his projects. These include:

- American Academy of Environmental Engineers' Superior Achievement Award (top prize) for the Wichita Area Treatment, Education and Remediation (WATER) Center (treatment/reuse of contaminated groundwater)

- American Academy of Environmental Engineers' Grand Prize in the Planning Category for Innovative Approaches at the Gilbert-Mosley Site

- American Academy of Environmental Engineers' Grand Prize in the Design Category for the Brooks Landfill Air Sparge System

- American Consulting Engineer's Council National Honor Award for Passive Treatment of Acid-Mine Drainage

- American Consulting Engineer's Council National Honor Award for the WATER Center

- American Consulting Engineers' Council National Honor Award for Bioremediation Pilot Plant

- American Academy of Environmental Engineers' Grand Prize in the Research and Development Category for Bioremediation Pilot Plant

- Civilian Research and Development Foundation Award for Best Project and Project Contributing to the Overall Improvement of Mankind (one of eight selected)

Dr. Olsen is also skilled in the application of state-of-the-art chemical transport models to assess ground water impacts of hazardous waste disposal. He has applied these models on 50 migration assessments. Dr. Olsen is the author (or co-author) of over 120 publications/presentations. He has recently co-authored papers on the adsorption behavior of arsenic, desorption characteristics of TCE, the geochemistry and treatment of chromium, speciation of lead in soils and identification of PRPs, metal distribution in streams, and comparison of methods to analyze metals in surface waters. Dr. Olsen has presented expert testimony in 20 cases on the fate and transport of inorganic and organic chemicals in the environment and the evaluation/cost of remedial technologies.

Presentations/Publications - Roger L. Olsen

Characterization of the Form and Species of Arsenic in Solid and Aqueous Phases to Evaluate Mobility and Treatment. Ground Water Summit Program, National Ground Water Association. April 17 - 20, 2005. (with R. Chappell and K. Whiting)

Environmental Health Problems of Lead Uptake among the Children of Kazakhstan: Assessment and Recommendations. Presentation to the Ministry of Health Care, the Ministry of Environmental Protection, and other educational and government agencies, in Astana and Shymkent, Kazakhstan. January, 2005 (with Rasmuson, J.O., Korchevsky, and Hall, D.).

Environmental Health Problems of Heavy Metal Contamination of Environment in Kazakhstan. Presentation to the Collegium of the Environmental Protection Agency of Kazakhstan. December 7, 2004 (with Korchevsky, A. and Rasmuson, J.O.).

Emerging Environmental Contaminants: Perchlorate and 1,4-Dioxane. Presentation to the Los Angeles World Airport Environmental Staff. December 6, 2004.

Chemical Fingerprinting of Hydrocarbons in the Environment. Presentation to the Los Angeles World Airport Environmental Staff. December 6, 2004.

Water Disinfection Using Electrolytic Generated Silver, Copper and Gold Ions. J Water SRT - Aqua. Vol. 53, pp 567-572, 2004. (with R. Khaydarov, R. Khaydarov and S. Rogers).

In Situ Treatment and Characterization of Arsenic in Groundwater. 2004 Water Quality Conference. Ontario, California. October 27 -29, 2004

Fate and Transport of Ethanol Containing Fuels in the Subsurface. Invited Presentation, Ethanol Workshop. Cosa Mesa, California. July 27, 2004.

Liquid Assets. Publication in Civil Engineering. September 2004. (with P. Anderson and J. Kaufman).

Environmental Remediation and Education in Wichita, Kansas. Proceedings of WEFTEC 2004. (with P. Anderson and J.R. Kaufman).

Demonstration of a Bioavailable Ferric Iron Test Kit . Presented at the Fourth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA. May 24-27, 2004. (with Pat Evans, Rick Chappell, John Eisenbeis, Mary Trute, Carmen Lebron, John Wilson, Eric Weber, John Kenneke, B.T. Thomas, Tom Dichrisina and John Drexler).

Case Histories and Comparison of two "Brownfields" Sites in Kansas and Indiana USA. Invited Presentation. Proceedings of Brownsfields 2004 Conference. Wessex Institute of Technology. June 15, 2004. (with M. Burgess).

Case Studies of Exposure and Remediation Conducted Resulting from Lead Smelter Emissions. Presentation at the American Industrial Hygiene Conference & Expo 2004. May 11, 2004.

Approaches to Human Health Risk Assessment and Industrial Safety Evaluation in the United States of America and Kazakhstan. Presentation at Workshop on Risk Assessment given to Health Care Officials. Actobe, Kazakhstan. November 7, 2003.

International Approaches and Standards for Environmental Protection: the Experience of the United States of America. Presentation at Workshop on Environmental Management Systems. OJSC TNC Kazchrome, Kazakhstan. November 6, 2003.

Using Groundwater Biogeochemistry to Assess Remediation Goals at a Large, Multi-source Site. Proceedings of the Seventh International In Situ and On-Site Bioremediation Symposium. Orlando, Florida. June 2-4, 2003. (With D. Adams, R. Winslow, A. Bourquin, and D. Brown)

Energy Effective Method of Water and Air Purification From Bacteria. Proceedings of the First International Conference on Environmental Research and Assessment. Bucharest, Romania. March 23-27, 2003. pp 164-170. (With R. R. Khaydarov, R.A. Khaydarov, and S. Rogers)

High-altitude, passive-water-treatment system design and construction for leach-pad effluent. Mining Engineering. 2003. pp 37-40. (With K. Whiting, R. Huffsmith, and D. Adams)

Case Studies: Remediation Around Lead Smelters. Presentations at Symposiums on Lead Health Effects, Toxicity, Remediation and Recommended National Programs. March 27, 2003. Shymkent, Kazakhstan. March 28, 2003. Almaty, Kazakhstan.

Results of Evaluations of Lead Poisoning in Children in Kazakhstan from 1997 to 2002. Presentations at Symposiums on Lead Health Effects, Toxicity, Remediation and Recommended National Programs. March 27, 2003. Shymkent, Kazakhstan. March 28, 2003. Almaty, Kazakhstan.

Case History of a "Brownfields" Site in Wichita, Kansas USA: Innovative Approaches to Groundwater Remediation. First International Conference on Brownfield Sites: Assessment, Rehabilitation and Development. 2002. WITpress, Southampton, England. pp 17-28. (With J. Brown and P. Anderson)

Case History of a "Brownfields" Site in Wichita, Kansas USA: Innovative Approaches to Groundwater Remediation. Invited presentation at Brownfields 2002 International Conference. September 2002. (With J. Brown and P. Anderson)

High Altitude Passive Water Treatment System Design and Construction for Leach Pad Effluent. Paper presented at the 2002 SME Annual Meeting, Phoenix Arizona. February 25-27, 2002. (With K. Whiting, R. Huffsmith, and D. Adams)

Stochastic Modeling of Stormwater and Receiving Stream Concentrations. Presentation at SME Annual Meeting, Environmental Session. February 25-27, 2002. (With R. Chappell and M. Hills)

Use of Fiber Optic Biosensors to Monitor Dichloroethane in Groundwater. International Conference on Remediation of Chlorinated and Recalcitrant Compounds. May 2002. (With K. Reardon and J. Eisenbeis)

Characterization of the Forms of Arsenic in Soil/Sediments to Evaluate Mobility and Treatment. Invited presentation to U.S. EPA Workshop on Managing Arsenic Risks to the Environment: Characterization of Waste, Chemistry, and Treatment and Disposal, Denver, Colorado. May 1-3, 2001.

Characterization of Sediments to Evaluate Sources and Mobility of Metals and Arsenic. Platform Presentation at International Conference on Remediation of Contaminated Sediments. October 10-12, 2001. (With K. Whiting, R. Chappell, and A. Bourquin).

Techniques to Evaluate the Mobility and Treatment of Arsenic in Soils. Presentation at Conference on Contaminated Soils, Sediments, and Water. University of Amherst. October 22-25, 2001. (With K. Whiting and R. Chappell).

Evaluation of Exposure Pathways and Lead Poisoning in Kazakh Children. Invited Presentation at the CRDF International Symposium. Scientific Cooperation with the Former Soviet Union: Results and Opportunities. Washington D.C. June 8-9, 1999. (With T. Slazhneva).

Blood Lead and Erythrocyite Protoporphyrin Levels in Children in Three Kazakstan Cities. *India Journal of Pediatrics*. 1999. (With Balkrishena Kaul, et al)

Overview of Reconnaissance of Abandoned Mine Sites, Poster at U.S. Army Corps of Engineers Conference on Restoration of Abandoned Mine Sites, RAMS Conference III, November 15, Reno, Nevada. 1999. (With B. Vince and K. Black).

Overview of Restoration of Abandoned Mine Sites, Poster at U.S. Army Corps of Engineers Conference on Restoration of Abandoned Mine Sites, RAMS Conference III, November 15, Reno, Nevada. 1999. (With B. Vince and K. Black).

Case History of a Successful "Brownfields" Site in Wichita, Kansas. Part 1: Innovative Approaches to Funding and Liability. *ASCE Conference Proceedings*. 1998. (With M.P. Mitsch and J. Brown).

Case History of a Successful "Brownfields" Site in Wichita, Kansas. Part 2: Innovative Approaches to Remediation. *ASCE Conference Proceedings*. 1998. (With M.P. Mitsch and J. Brown).

Correctional and Innovative Technology Evaluations for Groundwater Remediation at the Gilbert-Mosley Site in Wichita. Transactions of the 48th Annual Environmental Engineering Conference, University of Kansas, Lawrence. February 4, 1998. (With J.R. Kaufman).

Basic Principles and Results of Biological Monitoring on Lead Influence over Kazakh Children. Problems of Social Medicine and Health Care Management. No. 10, pp. 32-38. Almaty, Kazakhstan. December 1998. (With Tatiana Slazhneva, Andrey Korchevsky, Eduard Granovsky, James Rasmuson, Balkrishena Kaul, and Curt Chanda).

Evaluation of Exposure Pathways of Lead in Kazak Children: Risk Assessment, Biological Monitoring, and Public Health Campaign. Presentation made to CRDF. 1998. Also, Internet World Wide Web http://frontpage.crdf.inter.net/Abstracts/fund/kb1120.html.

Aerobic Bioremediation of TCE Contaminated Groundwater: Bioaugmentation with *Burkholderia cepacia* $PR1_{301}$. Presented at *In Situ* and On Site Bioremediation Conference, April 28-May 1, 1997. (With D.C. Mosteller, A.W. Bourquin, M.J. Smith, and K.F. Reardon).

Source Identification and Allocation of Metals in Stream Sediments Using Electron Microprobe Techniques. Presented at SME Annual Meeting, February 24-27, 1997. (With K.S. Whiting).

Identification of Sources of Metals in Stream Sediments Using Electron Microprobe Techniques. Presented at Tailings and Mine Waste Conference, January 13-17, 1997. (With K.S. Whiting).

Aerobic Bioremediation of TCE-Contaminated Groundwater. *Bioremediation.* 4(4):513-518. 1997. (With A.W. Bourquin, D.C. Mosteller, M.J. Smith, and K.F. Reardon).

Alternative Cleanup Criteria and Innovative Approaches for Groundwater Remediation. *Proceedings of Hazwaste World, Superfund XVII.* pp. 305-314. October 15-17, 1996.

Bioremediation of TCE Contaminated Groundwater Using Aerobic Bioaugmentation: Field Demonstration. *Proceedings of Hazwaste World, Superfund XVII.* pp. 10-19. October 15-17, 1996. (With D.C. Mosteller, A.W. Bourquin, M.J. Smith, and K.F. Reardon).

Aerobic Biotransformation during a Field Demonstration. Presented at Conference on Intrinsic Remediation of Chlorinated Solvents. April 2, 1996. (With D.C. Mosteller, A.W. Bourquin, M.J. Smith, and K.F. Reardon).

Anaerobic Dechlorination Activity in TCE Contaminated Groundwater. Presented at Conference on Intrinsic Remediation of Chlorinated Solvents. April 2, 1996. (With D.C. Mosteller, A.W. Bourquin, M.J. Smith, and A.L. Semprini).

The Geochemistry of Chromium Migration and Remediation in the Subsurface. *Ground Water.* September-October 1995. (With A. Davis).

Assessing the Usability of X-Ray Fluorescence Data. *Proceedings of Field Screening Methods for Hazardous Wastes and Toxic Chemicals.* pp. 1,251-1,263. February 22-24, 1995. (With R.W. Chappell).

Remedial Design at the Gilbert-Mosley Site. Presentation to the Construction Specification Institute. January 9, 1995.

A Scientist's Approach to Superfund Liability and Allocation. Presented to Air and Waste Management Meeting. 1995.

Testing for Development of Innovative Technologies. Invited presentation at Theis Conference on DNAPLs. 1995.

Passive Biological Treatment for Metals and *In Situ* Bioremediation of Chlorinated Solvents. Presented to Civil Engineering Dept., University of Minnesota. 1995.

Treatment of Mine Drainage Using a Passive Biological System: Comparison of Full-Scale Results to Bench- and Pilot-Scale Results. SME Convention, Albuquerque, New Mexico. February 14, 1994. (With K. Whiting, J.N. Cevaal, and R. Brown).

Source Identification and Allocation of Soil and Groundwater Contamination Near a Milling Superfund Site. Superfund XIV Conference. November 30-December 2, 1993. (With D.D. Wilson).

Evaluation of Stabilization Techniques for Mining/Milling Waste. Superfund XIV Conference. November 30-December 2, 1993. (With B. Howe).

Passive Microbiological Treatment of Acid Drainage from a Mining Site: Laboratory and Pilot-Scale Evaluations. Superfund XIV Conference. November 30-December 2, 1993. (With J. Cevaal and K. Whiting).

Bioavailability of Mercury in Cinnabar Ore Mine Wastes. Society of Toxicology, Annual Meeting. 1993. (With P.A. Billing, B. Howe, J.W. Drexler, and J.M. LaVelle).

Issues and Progress at Superfund Mining Sites. Lecture at University of Utah, Civil Engineering Department. May 10, 1993.

Can Ground Water Restoration Be Achieved? *Water Environment & Technology*. March 1993. (With M.C. Kavanaugh).

Bioremediation of Hazardous Wastes: Case Study of Land Treatment. Presentation at MIT Environmental Restoration Seminar, Civil Engineering Dept. February 1, 1993.

Comparison of Analytical Methods Used to Determine Metal Concentrations in Environmental Water Samples. *Journal of AOAC International*. 75:6. 1992. (With A. Davis).

Environmental and Hazardous Waste Evaluation and Remediation. Seminar for the Tashkent City Committee on Nature Protection and the Association of Ecological Cooperation, Tashkent, Uzbekistan. October 5-9, 1992.

Current Status of Superfund and RCRA: Examples at 20 Sites. Presentation at University of Colorado Civil Engineering Department. October 23, 1992.

Superfund and RCRA: Twelve years of Progress? Presentation at University of Minnesota Civil Engineering Department. November 6, 1992.

Mining and Milling Superfund Sites: Examples at 20 sites. Presentation at University of Minnesota Civil Engineering Department. November 5, 1992.

Remedial Technologies at CERCLA Landfills, Annual State of Minnesota Conference on Hazardous Waste. 1992. (With J.J. Eisenbeis).

Remedial Investigation and Feasibility Study at the Gilbert-Mosley Superfund Site: The Current Status. Presentation to the Kansas Geological Survey. May 21, 1992.

Case Study of Biological Treatment of Hazardous Waste from a Petroleum Refinery by Land Treatment. Presented at Bioremediation: Principles, Applications, Regulations, and Opportunities, Rutgers and Cook College. January 6-7, 1992.

Evaluating the Time Required for Pump and Treat Methods to Clean-up Ground Water Contaminated with Chlorinated Hydrocarbons. Kansas Water Pollution Control Association. April 29, 1992.

The Fate, Transport and Remediation of Hazardous Substances in Ground Water. Seminar for Minnesota Pollution Control Authority. April 21, 1992.

Superfund and RCRA: The Problems and the Progress. Presentation to the Civil and Mechanical Engineers Dept., Texas A & M. May 4, 1992.

Status of Superfund and RCRA Sites. MIT. February 14, 1992.

Bioremediation: Principles and Application. CDM, Chicago. January 14, 1992.

Treatability Studies at Superfund Sites. MIT. April 10, 1992.

Remediation of Solvent-Contaminated Soils by Aeration. *Journal of Environmental Quality.* 21:1. January-March, 1992. (With H. Kempton and A. Davis).

The Fate, Transport and Cleanup of Arsenic at a Superfund Site, HMC '91 Convention, Washington, D.C. December 3-5, 1991. (With J.J. Eisenbeis).

Evaluating Uncertainty in Determining VOC Distribution Coefficients: A Case Study, Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration, Houston, Texas. November 20-22, 1991. (With J.J. Eisenbeis, G. McCurry, and M.J. Smith).

Characterization and Treatment of Sludges at Wood Treating Sites: Case Studies at Four Sites, USEPA OERP & ORB Superfund Sludge Workshop, Edison, New Jersey. June 18-19, 1991.

Characterization and Treatment of Sludges at Mineral Processing Sites. USEPA OERP & ORB Superfund Sludge Workshop, Edison, New Jersey. June 18-19, 1991.

Distribution of Metals between Water and Entrained Sediment in Streams Impacted by Acid Mine Drainage. *Applied Geochemistry.* 6:333-348. 1991. (With A. Davis and D.R. Walker).

Principles Controlling Transport of Organic Chemicals in Ground Water. Seminar at Applications of Aqueous Geochemistry to Ground Water Investigations, Colorado Ground Water Association. April 10-12, 1991. (With A. Davis).

Predicting Aquifer Cleanup Times for TCE Contamination: Comparison of Results at Three Sites. Presentation at Applications of Aqueous Geochemistry to Ground Water Investigations, Colorado Ground Water Association. April 10-12, 1991.

Predicting the Transport of Arsenic in Ground Water at the Sharon Steel Superfund Site. Presentation at Applications of Aqueous Geochemistry to Ground Water Investigations, Colorado Ground Water Association. April 10-12, 1991.

Overview of Chemicals of Concern and Remedial Actions at Superfund Sites. Presentation, Colorado School of Mines, Environmental Science and Ecological Engineering Department. 1991.

Passive Treatment Technology Cleans Up Colorado Mining Waste. *Water Environment and Technology.* December 1990. (With S.C. Morea and T.R. Wildeman).

Predicting the Fate and Transport of Organic Compounds in Ground Water, Part 1. *Hazardous Material Control.* May/June 1990. (With A. Davis).

Predicting the Fate and Transport of Organic Compounds in Ground Water, Part 2. *Hazardous Material Control*. July/August 1990. (With A. Davis).

Using Chemical Analyses and Assessing Quality in Aqueous Environmental Monitoring Programs, Chemical Modeling of Aqueous Systems II. ACS Symposium Series, 416. 1990. (With T.R. Wildeman, L.S. Laudon, and R.W. Chappell).

Aeration as a Method to Remediate Solvent Contaminated Soil. HMCRI, Superfund 90. November 26-28, 1990. (With A. Davis and H. Kemper).

The Physics and Chemistry of Remediation by Extraction of Ground Water. Presentation to Regional Water Quality Control Board, Oakland, California. May 22, 1990.

Land Treatment of Hazardous Oily Refinery Waste. Presentation at AWWA/WPCA Hazardous Waste Treatment Technologies and Applications. Denver, Colorado. April 19, 1990.

Predicting Aquifer Clean-up Times for TCE Contamination. Third Annual Hazardous Waste Management Conference and Exhibition, New Mexico Hazardous Waste Management Society. March 12-15, 1990. (With R.W. Chappell).

Field Analytical Methods for Metals. HazMat International, Atlantic City, New Jersey. June 5-7, 1990. (With R.W. Chappell).

Adsorption and Desorption Characteristics of Chlorinated Volatile Organic Compounds. Ground Water Geochemistry Conference, NWWA, Kansas City, Missouri. February 20-22, 1990. (With M. Mehran and R.W. Chappell).

Predicting the Fate and Transport of Organic Compounds in Ground Water. Proceedings of 10th National Conference in Management of Uncontrolled Hazardous Waste Sites. HMCRI. November 27-29, 1989. (With A.O. Davis).

Remedial Alternatives at 20 Superfund sites, Presentation at New Mexico Hazardous Waste Management Meeting. 1989.

Field Screening for Metals and Cyanide. The 6th Annual New Jersey Environmental Exposition, Asbury Park, New Jersey. October 18, 1989. (With R.W. Chappell, and J.E. Alai).

Assessment of a Passive Treatment System for Acid Mine Drainage. 62nd Annual Conference, WPCF, San Francisco, California. October 16-19, 1989. (With S.C. Morea, S.C. and R.W. Chappell).

Land Treatment of Petroleum Waste, Hazardous Waste Impact Migration through Innovative Technology. 27th ASME Technical Symposium, Albuquerque, New Mexico. May 24-25, 1989.

Overview of Remedial Technologies Used at Superfund Sites. Presentation, Arizona State University, Environmental Engineering Department. 1989.

Organic Geochemistry Related to Subsurface Contaminant Transport. Proceedings of 9th National Conference on Management of Uncontrolled Hazardous Waste Sites. HMCRI. November 28-30, 1988. (With R.W. Chappell).

Fate and Transport of VOCs in Soils. Presentation at Region Water Quality Control Board Seminar, Oakland, California. 1988.

Assessment of a Passive Treatment System for Acid Mine Drainage at a Colorado Superfund Site. Proceedings of 9th National Conference on Management of Uncontrolled Hazardous Waste Sites. HMCRI. 1988. (With R.W. Chappell, T.R. Wildeman, and L.S. Laudon).

Cleanup Technologies Used at RCRA and Superfund Sites. Presentation, University of Colorado at Denver, Environmental Engineering Department. 1988.

Project Data Quality Objectives and the Role of Field Screening Techniques for Metals, Pittsburgh Conference and Exposition on Analytical Chemistry and Applied Spectroscopy, New Orleans, Louisiana. February 22-26, 1988. (With R.A. Cheatham, R.W. Chappell, and A.O. Davis).

The Use and Abuse of Eh Measurements: Are They Meaningful in Natural Waters. Ground Water Geochemistry Conference, Denver, Colorado. February 16-18, 1988. With A.O. Davis and R.W. Chappell).

Land Treatment of Hazardous Wastes. Presentation at Dallas Hazardous Waste Society Meeting. 1988.

Transport and Fate of Creosote, Pentachlorophenol, and Inorganic Arsenicals in the Environment. Presentation at U.S. EPA Seminar on Woodtreating Superfund Sites, Kansas City. 1987.

Estimating the Mobility of Arsenic in Soils through the Use of Leach, Column and Sorption Experiments. Haztech Canada. May 12-14, 1987. (With A.O. Davis and R.W. Chappell).

Distribution Coefficient of Trichlorethylene in Soil-Water Systems. *Ground Water*. 25:3. 1987. (With M. Mehran and B.M. Recter).

Transport and Fate of Heavy Metal in the Environment. Presentation at U.S. EPA Seminar on Mining Waste at Superfund Sites. Denver, Colorado. 1986.

An Evaluation of the Impact of Gregory Tailings on North Clear Creek Water Quality as Related to Potential Remedial Alternatives. Haztech International, Denver, Colorado. August 11-15, 1986. (With A.O. Davis and R.W. Chappell).

Demonstration of Land Treatment of Hazardous Wastes. 7th National Conference on Management of Uncontrolled Hazardous Waste Sites. 1986. (With P.R. Fuller and E.J. Hinzel).

Rapid, Cost-Effective GC Screening for Chlorinated Pesticides and Volatile Organics at a CERCLA Site. 7th National Conference on Management of Uncontrolled Hazardous Waste Sites. 1986. (With R.A. Cheatham and J. Benson).

Portable X-Ray Fluorescence as a Screening Tool for Analyses of Heavy Metals in Soils and Mine Waste. 7th National Conference Management of Uncontrolled Hazardous Waste Sites. 1986. (With R.W. Chappell, R.W. and A.O. Davis).

Use of a Portable X-Ray Analyzer and Geostatistical Methods to Detect and Evaluate Hazardous Metals in Mine/Tail Tailings. 6th National Conference of Uncontrolled Hazardous Waste Site, Washington, D.C. 1985. (With Scott Mernitz).

Adsorption Characteristics of Trichloroethylene - A Comparative Analysis. American Geophysical Union, Spring Meeting, Cincinnati. 1984. (With Mehran Mohsen).

Brine Reservoirs in the Castile Formation, Southeastern New Mexico. U.S. Department of Energy, Waste Isolation Pilot Plant, TME 3153. 1983. (With R.S. Popielak, R.L. Beauheim, S.R. Black, W.E. Coons, and C.T. Ellingson).

The Geochemistry of the Castile Brines: Implications for Their Origin and Impact on the WIPP Site. *Proceedings of the Scientific Basic for Nuclear Waste Management, Materials Research Society.* 1983. (With W.E. Coons and D. Meyer).

Predicting Water Quality and Quantity to be Discharged from a Proposed Underground Uranium Mine. First International Mine Water Congress, Proceedings, Budapest, Hungary. 1982. (With R.S. Popielak, R.S. and M.J. Taylor).

Investigations of Pressurized Brine Pocket, WIPP Site, Carlsbad, New Mexico. Presentation at the Annual Meeting, Geological Society of America, New Orleans. 1982. (With R.S. Popielak, S.R. Black, and C.T. Ellingson).

The Crystal and Molecular Structures of Acetamidinium Tetratchlorocuprate and Tetrachlorocobaltate. T-2170, Colorado School of Mines, Golden, Colorado. May, 1979.

Soil Decontamination at Rocky Flats. Transactions of American Nuclear Society. *Proceedings of the Conference on Decontamination and Decommissioning of Nuclear Facilities.* 1979.

Soil Characterization Procedures. CRD 78-096, Rockwell International, Rocky Flats Plant, Golden, Colorado. 1978.

ROUX

Professional Profile

Walter H. Eifert
Principal Hydrologist

Technical Specialties:
Applications of and constructed treatment wetlands (CTW) and phytoremediation technologies for the treatment of ground water, stormwater runoff, municipal and industrial wastewaters and non-point source pollution. Watershed Management including surface water and wetland mitigation/restoration, ecological assessments, lake and stream remediation, surface water modeling and flood plain investigations.

Experience Summary:
23 years of experience: Principal Hydrologist at Roux Associates; Senior Scientist/Project Manager at BBI Environmental; Senior Scientist/Manager of Water Quality at York Services Corporation; Water Resources Planner/Project Manager at E. A. Hickok and Associates; and Research Associate at the Wyoming Water Research Center, University of Wyoming.

Credentials:
M.S. Water Resources Management, 1982
B.S. Aquatic Biology, 1980

Professional Affiliations:
American Water Resources Association
Society of Wetland Scientists
Water Environment Federation
Interstate Technology Regulatory Cooperation (ITRC)
Gamma Sigma Delta, Agricultural Honorary
Sigma Xi, Research Honorary

U.S. Patent
U.S. Patent Awarded on April 13, 1999
Enhanced Sub-Surface Flow Constructed Wetlands
Patent No. 5,893,975

Key Projects:

Watershed Management

- Presently the surface water hydrologist for the Industri-Plex Site Remedial Trust (ISRT), Woburn, MA. Services provided to-date have included the preparation of sediment fate and transport elements of the GSIP Work Plan, the completion of a conceptual design and cost analysis for an enhanced sediment retention facility in the Hall's Brook Holding Area and participation in meetings with the Agency.
- Completed a conceptual design and cost analysis of an enhanced sediment retention/treatment system for the Industri-Plex Site, Woburn, MA. The design consisted of retrofitting a CTW/Phytoremediation system into the Halls Brook Holding Area (HBHA) pond and wetlands. The functional objective was to reduce sediment export from the Site by 85%. The project was completed for the ISRT in March 1998. Implementation is currently pending the completion of a detailed sediment fate and transport investigation.
- Completed a watershed management needs analysis in support of a 27-hole golf course development project proposed at a 700-acre inactive industrial Site in eastern Virginia. The analysis included completion of watershed runoff modeling, buffer zone determinations, integrated pesticide management programs, irrigation needs and water quality management. The study recommended use of wastewater re-use to minimize water supply and treatment costs and to provided passive capture and treatment of stormwater runoff.
- Project Manager for the Minnesota River Study, a Twin Cities Metropolitan Waste Control Commission Project involving the identification of feasible alternatives to improve receiving water quality in lieu of constructing advanced wastewater treatment facilities. The project resulted in the identification of an alternative that would be protective of in-stream water quality criteria and provide over $20,000,000 in savings to the Commission.
- Performed an extensive surface water modeling analysis of the 183 square mile Minnehaha Creek Watershed, Minneapolis, Minnesota. The project was completed as part of a $400,000 Watershed Management Plan prepared for the Minnehaha Creek Watershed District. The modeling analysis was performed using the USCOE HEC-1 and HEC-2 software programs. Activities included model calibration and simulation of runoff from a series of design storms. Modeling results were used to quantify storage requirements and floodplain management needs in the watershed and were subsequently used to develop capital improvement recommendations for the District.
- Performed TR-55 runoff modeling for numerous projects in MN, WV, VA, MA, PA and NY. The modeling is routinely conducted to quantify pre- and post-development changes in runoff hydrographs associated with design storms of 2, 5, 10, 25, 50 and 100-year return frequencies. The TR-55 software was developed by the U.S. Soil Conservation Service and is widely used in small-scale hydrologic investigations.
- Performed a hydrologic evaluation along a reach of the Coeur D'Alene River adjacent to the Bunker Hill Superfund Site, Kellogg, Idaho. The project was conducted in support of a Master Remediation Plan developed for the Site. Hydraulic characteristics of the study reach were evaluated through the completion of a computer modeling analysis using the HEC-2 Water Surface Profile program developed by the ACOE. Modeling results served as the basis to develop 100-year flood profiles through the study reach. The project was completed for Site PRPs with the results used to support planned remediation activities at the Site.
- Project Manager for the design and completion of a sediment fate and transport analysis at a large coal mine in central Wyoming. The project was conducted to identify alternative sediment control measures at the Site. SEDIMOT II modeling served as the basis to quantify sediment fate and transport dynamics and evaluate potentially viable alternatives. The project was performed for the Office of Surface Mining, Denver Colorado.
- Project Manager for the completion of the McLeod County Landfill post-encroachment floodplain analysis, McLeod County, Minnesota. The project was conducted to identify encroachment limits for a proposed landfill expansion into the 100-year floodplain of the Crow River. Simulation analyses using the ACOE's HEC-2 software were used to identify allowable limits. The modeled encroachment was approved by the Minnesota DNR and FEMA. The modeled results were within 0.01inches of a 100-year runoff event that occurred at the Site the following year.
- Completed numerous hydrologic and floodplain investigations in support of Site remediation projects and stormwater permitting activities. Examples of applicable projects include a focused hydrologic investigation to quantify base flow discharge rates and volumes at an industrial site in New York; a hydrologic/natural attenuation

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investigation at the OTT/Story/Cordova Superfund Site in Muskegon, Michigan; a floodplain simulation analyses of Shingle Creek, a highly developed tributary of the Mississippi River near Minneapolis, MN; stormwater runoff investigations at two E.I. DuPont De Nemours Plants located in Dunbar, PA and Falling Waters, WV; hydraulic/treatment needs analyses for two large aluminum reduction facilities located in Frederick, MD and Ravenswood, WV; and a hydrological water quality investigation at a major incineration facility located in New York City. The investigations included the design and implementation of hydrologic and water quality monitoring programs, data interpretation and report generation.

- Designed, managed and completed several hydrologic investigations using dye dilution techniques. The studies included time-of-travel investigations, discharge calculations, and hydrograph development and routings. Example projects included a surface water/ground-water interaction study completed for the USGS in southeastern Wyoming; a time-of-travel investigation along a 3-mile reach of the Runnins River in RI; a surface water runoff analysis at an industrial site in VA and a combined sewer overflow assessment at a large steel manufacturing facility in western PA.
- Designated expert witness as a hydrologist in a property damage lawsuit attributable to flooding. Litigation support activities have included a review and assessment of the subject property and the preparation and submission of a technical evaluation report. The case was settled out of court prior to trial. The subject site was located in Houston, Texas.

Aquatic and Terrestrial Ecology

- Project Manager for the preparation of a detailed watershed management plan for the Minnehaha Creek Watershed District, Minneapolis, MN. Tasks included completion of a comprehensive physical, chemical and biological inventory of the 183 square mile watershed, computer simulation analyses of the hydrologic and water quality response under a variety of design storm conditions, and the development of a capital improvements program and implementation schedule.
- Project Manager for the Living Lakes Program, a six-year multi-million dollar project to develop and demonstrate cost-effective technologies for the neutralization of acidic surface waters and the restoration of important fisheries. The project included the intensive field sampling of fish, benthic macroinvertebrates and zooplankton communities in 39 lakes and 13 streams located in the northeastern, mid-Atlantic and upper Midwest regions of the U.S. Results were used to develop guideline criteria for lake and stream restoration projects.
- Completed a field investigation and evaluation of three aquatic habitat assessment procedures widely used in in-stream flow investigations. The project included the extensive analysis of benthic macroinvertebrate community abundance and diversity, seasonal effects of varying hydrologic flow regimes, temporal variations in in-situ water quality and an assessment of the population dynamics of indigenous fish communities. The project resulted in the preparation of an ocular habitat assessment tool designed to facilitate and expedite preliminary in-stream flow field investigations. The project was completed for the Wyoming Water Research Center of the University of Wyoming.
- Project Manager for the completion of the Long Lake Chain of Lakes restoration project. The principal objective of this USEPA Phase II restoration project included implementation of a series of hydrologic and water quality improvement elements collectively designed to reduce non-point source pollutant entry into the lake complex, improve in-lake water quality conditions and re-establish viable recreational fisheries in the seven lakes comprising the chain. The project was completed for the Rice Creek Watershed District and Minnesota Pollution Control Agency through funding provided by a USEPA Clean Lakes grant.
- Project Manager for the completion of the Moore Lake restoration project, a USEPA Phase II Clean Lakes project designed to restore recreational fisheries and improve water quality to a metropolitan lake impaired by non-point source pollution. Key restoration elements included the installation of a hypolimnetic aerator to oxygenated bottom water, placement of 6 acres of liner on the lake bottom to reduce sediment oxygen demand and the installation of a Biologically Activated Soil Filtration Unit (BASFU) to reduce pollutant loadings in stormwater runoff. The project was jointly completed for the city of Fridley, Minnesota and the Minnesota Pollution Control Agency.
- Managed and completed a preliminary water quality and fisheries study for Summit Lake, a high priority recreational resource located in Greenbriar County, WV. The principal study objectives included completion of a baseline evaluation of tributary and in-situ water quality and resident biological communities. Study results provided the framework for the preparation of a USEPA Clean Lakes grant application. The project was jointly sponsored by the West Virginia Department of Natural Resources and the Monongahela National Forest.
- Project Manager for the completion of a Phase I diagnostic feasibility study on Big Kandiyoki Lake near Willmar, Minnesota. The principal objectives of the project included the collection and analysis of in-lake physical, chemical and biological data, problem diagnosis and the development of feasible lake restoration alternatives. The overall goal was to improve in-situ water quality and re-establish viable biological communities. The project was jointly completed for Big Kandiyoki County, the Minnesota Pollution Control Agency and USEPA Region V.
- Project Manager for the completion of the Prior Lake/Spring Lake restoration project. Key project objectives included completion of a USEPA Phase I Diagnostic/Feasibility investigation and the restoration of water quality and recreational fisheries to both project lakes. The project included the extensive collection and analysis of water quality, fisheries, benthic macroinvertebrates, zooplankton and phytoplankton data. The project was jointly completed for the Spring Lake/Prior Lake Watershed District, Minnesota Pollution Control Agency and USEPA Region V.
- Completed physical, chemical and biological assessments of 63 miles of streams located in the Monongahela National Forest, West Virginia. The survey was conducted to evaluate the existing biological conditions of impacted streams and to develop remedial recommendations to facilitate biological recovery. The project was completed for the U.S. Forest Service, Elkins, West Virginia.

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- Designed, managed and completed a natural resources data assessment of Yellowstone National Park, Wyoming. The principal objective of the project was to obtain, review and critique ecological studies completed for the Park. The project resulted in the development of a computerized data base containing over 10,000 citations of studies completed within the Park. The project was completed for the U.S. National Park Service, Gardner, Montana.
- Designed, managed and completed an ecological data assessment of the Big Horn Canyon National Recreation Area, Wyoming. The project resulted in the collection, analysis and computerization of approximately 4,000 literature articles on the Area. The work was performed for the U.S. National Park Service, Moran Junction, Wyoming.
- Evaluated the aquatic ecology of two blue ribbon trout streams in southeastern Wyoming. The study included assessments of fish population dynamics, benthic macroinvertebrate diversity and abundance, zooplankton migration, hydraulic stability and water quality characteristics. The study was performed for the U.S. Department of the Interior.
- Developed a lake restoration model that evaluated the morphemetric and chemical characteristics of an acidified lake and calculated the dosage of neutralization agents. The model included an economic subroutine to evaluate design costs. The work was performed for the Edison Electric Institute, Washington, D.C.
- Designed and implemented an extensive wetlands monitoring program for a high value mixed hardwood swamp/emergent wetlands system adjacent to the Runnins River, East Providence, Rhode Island. The project included the development of a quantitative model to assess potential long-term ecological impacts to the wetlands from an extensive ground-water extraction system operating nearby. The project is scheduled for completion in late fall, 1998.
- Performed an ecological evaluation of a municipal solid waste landfill facility in Nicholas County, West Virginia. The evaluation was conducted in accordance with permitting requirements necessitated by a planned expansion of the landfill. The ecological resources evaluated included threatened and endangered species, terrestrial and aquatic habitats and vegetative communities. The findings were submitted to the West Virginia Division of Environmental Protection as part of the Permit application. An expansion permit was approved for the project.
- Completed preliminary ecological evaluations at a former fibers manufacturing facility in Williamsburg, Virginia. The assessments were conducted in a 70-acre headwater drainage/wetlands system in support of a leachate mitigation project being performed at the Site. Results of the assessments were reviewed and approved by the EPA, US-FWS, ACOE and Virginia DEQ as part of the permitting process. Federal, state and local permits have been issued for the project.

Wetlands

- Project Manager for the design of a 16-acre, 150,000 GPD CTW treatment system for the removal of heavy metals in diffuse leachate discharging from a 33-acre industrial waste landfill. The final design consisted of a staged treatment sequence containing passive pretreatment elements, a surface flow CTW treatment cell (aerobic), a subsurface flow CTW treatment cell (anaerobic) and a CTW polishing cell. Key features include entirely passive operation, metals precipitation in non-toxic sulfide forms and removal efficiencies to NPDES discharge standards or better. The system is projected to provide over $20 million in remediation/treatment cost savings. The system was constructed in the fall of 1998 and activated in January, 1999. Since that time, the system has consistently reduced zinc levels by greater than 99.9%.
- Project Manager for the design of a CTW system to treat landfill leachate at the Nicholas County Sanitary Landfill in Summersville, WV. The 25,000 GPD project included characterization and analysis of the leachate waste stream, system design, permitting and regulatory liaison. The facility was approved for construction by the WV Division of Environmental Protection (WV-DEP). An NPDES permit to discharge was issued by WV-DEP.
- Project Principal and lead designer of an enhanced natural treatment system at a new smelter facility under development in Iceland. Major treatment components of the system include grassed drainage swales, pocket CTW cells, two large terminal CTW units and hydraulically connected infiltration basins. The system is being designed to carry and treat runoff from a 20-year storm, and attain zero discharge for design storms of up to 25-year return frequencies.
- Designer of a 22,000 GPD municipal wastewater treatment system integrating CTW technology with conventional treatment methods. The design included use of several innovative features that resulted in a 50 percent reduction in CTW treatment area. The subsurface flow-type system serves a new 100-home subdivision and is designed to treat to tertiary standards. The system was constructed and activated in the summer of 1995. Performance to-date has been well within the facility's NPDES discharge limitations.
- Project Manager for design of a CTW treatment system to remove heavy metals at a large Superfund site in northern Idaho. The design included passive collection and treatment of an 8-cfs metals-laden wastewater stream. Target metals included zinc, lead, cadmium, iron and arsenic. The constructed wetlands alternative was approved for use in the ROD issued for the site.
- Project Manager for the design, permitting and construction of two municipal wastewater treatment systems using CTW treatment technology. The systems included a 3,000 GPD secondary facility located in Jefferson County, WV, and a 20,000 GPD facility constructed in nearby Morgan County, WV. The systems have been in operation since 1990 and 1992, respectively, and are operating in conformance with established NPDES discharge limitations.
- Project Manager for the design and evaluation of a pilot CTW treatability project at a large aluminum reduction/manufacturing facility in central Maryland. The pilot system is designed to sequentially remove cyanide and fluoride in leachate collected from an on-site industrial waste landfill. Pre-design work elements included completion of a waste stream characterization analysis and preparation of a heavily annotated treatability white paper. The pilot-scale design contains several individually configured CTW treatment cells to evaluate and optimize contaminant removal potentials.

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- Project Manager for the design, installation and evaluation of a pilot-scale CTW treatment system at a major northeast petroleum terminal. The pilot system is designed to optimize the aerobic biodegradation of BTEX contaminants in shallow ground water. Key features include passive capture and in-situ treatment of the contaminated ground-water plume, sub-surface flow operation to minimize freezing, vector, odor and exposure concerns, and the installation of a passive nutrient addition chamber to enhance microbial growth and biodegradation efficiency. The system was installed in 1996 and is currently providing a BTEX removal efficiency greater than 95%.
- Inventor of two innovative CTW treatment system appurtenances designed to optimize system performance and reduce long-term treatment costs. Patent applications to the U.S. Patent office were submitted in February, 1997. A U.S. Patent (i.e., No. 5,893,975) was awarded in April, 1999.
- Project Manager for review and critique of the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989 Edition). The project was completed for the American Mining Congress, Washington, D.C.
- Project Manager for the design and construction of a CTW stormwater treatment system for a major eastern railroad corporation. The system included the passive treatment of oil and grease, metals and nutrients in a 3-acre subsurface flow type CTW treatment sequence. The system is sized to treat a hydraulic load of approximately 200,000 GPD. Coordinated completion of several jurisdictional wetlands studies in the States of NY, WI, MN, WV and RI.
- Project manager for the mitigation of impacted wetlands at a chemical Superfund Site in Wilmington, Delaware. The project involved completion of a functional assessment of the impacted wetlands, the identification of mitigation alternatives and the development and implementation of a cost effective mitigation plan jointly addressing both EPA mitigation requirements and NRDA claims. The plans involved the purchase and restoration of an off-Site wetland abutting a State wildlife area. Client responsibilities were limited to purchase of the marsh and a small compensatory contribution to facilitate the restoration. As restoration activities, long-term monitoring and maintenance were transferred to the State. Client savings were estimated at $1.5 million.
- Completed the delineation of an extensive intertidal freshwater wetlands at a large industrial site on Staten Island, NY. The 1998 delineation was field verified by the New York Department of Environmental Conservation and resulted in no changes to the original delineation performed by Roux Associates. The final negotiated boundaries reduced the extent of the originally defined wetlands complex thereby providing more land area for development.
- Completed a three-year evaluation of a protected intertidal wetlands complex at a petrochemical facility in Rhode Island. The evaluation included the initial delineation of wetland boundaries and quarterly field monitoring to assess potential impacts from nearby ground-water extraction wells. No impacts have been identified to-date. The project is scheduled for completion in early 1999.
- Project Manager for a CTW treatability investigation at a northeast Superfund site. The study investigated the potential use of CTW technology for the remediation of heavy metals, organics and conventional pollutants from Site ground water. Specific areas evaluated included contaminant removal mechanisms, retention efficiencies, constituent fate dynamics, bioavailability of processed contaminants, cost efficiency, life expectancy and preliminary design criteria. Results deemed the technology both technically and cost-effectively viable for use at the Site. Bench and pilot scale testing are presently pending.
- Project Manager for an investigation into the potential use of CTW technology to remove elemental phosphorus from ground water at a southeast industrial facility. The multi-phased project included completion of a wastestream characterization analysis, preparation of a treatability white paper, a mesocosm evaluation of processing mechanisms and implementation of a pilot-scale testing program. Results of the white paper supported potential applicability for use of the technology at the Site. Nine CTW mesocosm cells were constructed with several different types of substrates and emergent macrophytes.

Phytoremediation

- Project principal/designer of a Pilot Scale Enhanced Natural Systems project near Charleston, SC. Key project elements included the design of a 2-acre phytotechnology plot, constructed treatment wetlands system and vegetated filters to improve stormwater quality and reduce the volume of stormwater discharging from an active industrial Site. Supporting components included the evaluation of eight phytotechnology species in a greenhouse environment and the completion of extensive column testing experiments on various types of treatment media. The system was installed in late 2002 with startup planned for late spring, 2003.
- Completed the installation of 4,000 hybrid poplar trees (i.e., *Populus deltoides x nigra* DN-34) on the surface of an un-capped industrial waste landfill located on the Virginia Peninsula near Norfolk, Virginia. The principal objective is to evaluate use of the trees to consumptively utilize effluent released from an on-Site leachate treatment system. The 3-acre demonstration project will be expanded to include 34 acres of landfill surface if deemed successful. The trees were planted in the spring of 1999 and are presently being evaluated monthly. Full-scale implementation will result in a zero-discharge designation thus saving an estimated $250,000 in annual O&M expenses.
- Prepared and implemented a phytoremediation work plan to mitigate BTEX constituents and prevent the off-Site mitigation of contaminated ground water from an active chemical manufacturing facility in upstate, New Jersey. A total of 660 hybrid poplar trees were planted in barrier fashion at the apex of the ground-water plume and along the down-gradient boundary of the property. The trees were planted in the spring of 1999 and will be evaluated over a three-year maturation period. The project is anticipated to attain excellent in-situ treatment of BTEX constituents and prevent the off-Site migration of the ground water plume. Use of the technology at the Site was approved by state and federal regulatory agencies.
- Project Manager for the design and installation of 4,000 hybrid poplar trees at a major petrochemical transfer terminal located near Providence, Rhode Island. The principal objectives of the project include the in-situ

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treatment of BTEX constituents through rhizosphere bioremediation and the hydraulic containment (i.e., phytostabilization) of the ground-water plume discharging to a jurisdictional wetland. Work performed to date has included the completion of a soils characterization analysis, preliminary rooting tests in Site soils, the preparation of a detailed planting plan and the planting of 2,000 hybrid poplar trees. Planting activities were completed in April, 2000. The trees are presently established and growing well (greater than 95% survival). Quarterly performance evaluations are scheduled through 2004

- Project Manager for the design, installation and evaluation of a 4,000-tree phytostabilization project at an inactive industrial landfill Site near Detroit, Michigan. The design objective was to reduce leachate generation in two inactive industrial waste landfill cells located on the property. The phyto plantings (hybrid poplar trees) were initially installed in barrier fashion around and hydraulically upgradient of each cell in May, 1999. A phytotoxic agent in Site soils resulted in low initial transplant success. A phytotoxicity and rooting test investigation was conducted to identify, isolate, and mitigate the causative agents. The Site was replanted in April, 2000. A recent survival audit indicated greater than 97% of the trees have survived and or growing. Quarterly evaluations are scheduled to continue through tree maturation in 2004.
- Performed an initial assessment to determine the viability of using phytoremediation technology to mitigate PAHs in ground water at a former Manufactured Gas Plant (MGP) Site in New Hampshire. An additional objective was to evaluate potential use of the technology to hydraulically preclude the off-Site migration of ground water (phytostabilization). Work products included the preparation of a treatability "White Paper" and the preparation of a phytoremediation planting plan.

Litigation Support/Expert Witness

- Designated expert witness as a hydrologist in a property damage lawsuit attributable to flooding. Litigation support activities have included a review and assessment of the subject property and the preparation and submission of a technical evaluation report. The case was settled out of court prior to trial. The subject site was located in Houston, Texas.

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Current Positions:

Vice President. - Blasland, Bouck & Lee, Inc., Beverly, MA

Education:

M.S. in Environmental Engineering, University of Massachusetts, Lowell, 1994.
B.S. in Civil Engineering, University of Maine, 1985.

Previous Employment:

Haley & Aldrich, 1985 – 1986.
Ebasco/ Enserch Environmental/ Foster Wheeler Environmental, 1986 – 1998.

Professional Experience:

Coosa River, AL. Project manager for the off-site component of a RCRA facility investigation (RFI) evaluating the presence and significance of PCBs in a 15,000-acre reservoir and 40 miles of tributary creeks associated with the Coosa River. The investigation includes a sediment sampling program to characterize the creek system, soil sampling efforts for the adjoining floodplain area, a fish collection program, and surface-water sampling and modeling to assess the PCB fate and transport within the creek/river system.

New Bedford Harbor Superfund Site, New Bedford, MA. Project manager for remediation of approximately 500,000 cy of PCB- and heavy metals-containing sediment. This design-build project included dredging and shoreline containment of sediment in confined disposal facilities (CDFs). Prior to the remedial design phase of this project, served as the project manager responsible for a RI/FS for an 18,000-acre area including sediment, surface water and biota sampling, fate and transport modeling, and human health and ecological risk assessment components. The project also included pilot-scale treatability studies to evaluate treatment options for 15,000 cy of sediment from the hot spot area of the site. These pilot-scale studies included: solvent extraction, vitrification, thermal desorption, solid-phase dechlorination, gas-phase chemical reduction, and solidification/ stabilization. Played an active role in community outreach efforts as the technical spokesperson to the New Bedford Harbor Forum Group and its Treatability Study Subcommittee.

Confidential Waterway in the Northeastern United States. Task leader for the dredging and dredged material transport components for this confidential project. Responsible for designing the removal of 2.65 million cy of PCB-containing sediment while attaining strict performance standards for production, resuspension, and post-dredging residuals.

Former Coal Tar Manufacturing Facility, Everett, Massachusetts. Project manager for a shoreline sediment site located in Boston Harbor that includes a 10-acre upland parcel and approximately 100,000 cy of PAH-containing sediment in a tidal river. Responsible for developing the technical strategy to remove these sediments as part of a Release Abatement Measure (RAM) and the installation of a shoreline wall to sever the link between the uplands portion of the site and the river. As part of designing the RAM, recently led the efforts to complete a large-scale pilot project that tested methods to dredge, process, and transport sediment from the site.

Lake Okeechobee, FL. Feasibility study (FS) lead evaluating a range of remedial alternatives for this 730 square mile lake with approximately 200 million cy of sediment that may require management. The evaluation of remedial alternatives includes consideration of the lake's ecology and critical habitat, archeological/cultural significance, and multiple water-dependent uses including agricultural and public water supply, a waterway between the Gulf of Mexico and the Atlantic Ocean, flood control, and recreation/ tourism.

Convair Lagoon, San Diego, CA. Project engineer for a San Diego shoreline site with PCB-containing sediment. Responsible for conducting FS evaluations, assessing PCB cleanup levels, and directing design activities for the selected cleanup alternative. Design elements included capping, limited removal, water treatment, relocation of area storm drains, and water-quality monitoring to protect environmental resources during construction. Provided expert witness testimony in support of the remedial cleanup plan to the California Regional Water Quality Control Board during the public hearing process. Also supported technical outreach efforts with the local grass-roots community organization, the Environmental Health Coalition.

Passaic River Superfund Site, NJ. Project manager for an FS to assess sediment containing dioxins, furans, and a wide range of organic and inorganic constituents within a six-mile portion of this urban river. Initial FS efforts are focused on evaluating the universe of remedial technologies including an evaluation of sediment treatment technologies and performing a series of site-specific treatability studies.

Howes Sound, Squamish, B.C., Canada. Project manager for a large sediment site adjacent to a former chlor-alkali manufacturing facility. Responsible for evaluating historical sediment, surface water, biota, groundwater, and aerial photographs to assess the potential impact of a former landfill in the area.

Confidential Site, Fraser River, Burnaby, B.C., Canada. Project coordinator for the design and construction activities for this site located on the Fraser River. Responsible for coordinating implementation of the $15 million capping and dredging remedy.

Ashtabula River, Lake Erie, OH. Sediment strategy specialist responsible for developing cleanup approaches for approximately 1 million cy of PCB-containing sediment.

Confidential Site, Lake Champlain, NY. Technical lead for the design and implementation of a monitoring program to assess dredging operations to remove approximately 120,000 cy of PCB-containing sediment from the lake.

Berry's Creek NPL Site, Northern NJ. Technical lead for the engineering aspects of this estuarine mercury discharge NPL site encompassing more than 400 acres of the Hackensack Meadowlands. Responsible for evaluating a range of potential remedial scenarios for both the creek and wetland portions of the site, including developing detailed cost estimates.

Confidential Site in Western U.S. Technical lead evaluating the potential environmental liability associated with a large watershed adjacent to an NPL site that historically supported mining operations. The evaluation included potential remedial response activities and natural resource damage aspects of this 1,500 square mile watershed.

Former Fireworks Manufacturing Site, Southeast MA. Principal-in-charge for studies conducted at this former fireworks manufacturing site to assess the potential presence of mercury. The site includes a large pond and creek system that received mercury through the release of mercury fulmonate used in the manufacturing process. The facility also manufactured munitions during war times and as a result, the investigation activities included precautions for unexploded ordinances (UXOs) still present in some site areas.

Major Northeast Waterway. Peer review lead for a former industrial site located on a major waterway in the Northeast. Responsibilities included peer review of an FS prepared by the project's consultant. The review focused on checking the document for the appropriate evaluation of remedial alternatives and recommendations.

Commencement Bay Superfund Site, Middle Waterway, WA. Senior technical consultant to the remedial design team for the Middle Waterway Problem Area of the Commencement Bay Superfund Site. This 24-acre area of the bay has sediments with elevated levels of PAHs and PCBs. As the senior technical consultant, was responsible for reviewing project deliverables and providing technical direction and guidance to the project team for developing the overall design strategy.

Commencement Bay Nearshore/Tideflats Superfund Site, WA. Project engineer providing technical support for the Commencement Bay Nearshore/Tideflats Superfund site. This support included a variety of technical tasks to assist in developing a final remedy for the Hylebos Waterway portion of the site. Responsible for evaluating sediment remediation technologies including capping, dredging, subaqueous and nearshore containment, as well as sediment and water treatment.

Norwood PCB Superfund Site, Norwood, MA. Project manager for treatment operations to remediate 60,000 tons of PCB-containing soil/sediment using an innovative technology, solvent extraction. Project activities included preparing detailed engineering plans and specifications, and conducting contract negotiations with technology vendors.

Massachusetts DEP Priority Disposal Site, Shirley, MA. Project manager for MCP Phase II, III, and IV studies to address this 51-acre former industrial site with petroleum hydrocarbons, heavy metals, SVOCs, and VOCs in both soil and groundwater. Also responsible for developing cost estimates for several remedial alternatives to address an on-site coal ash landfill.

Pinette's Salvage Yard Superfund Site, Washburn, ME. Remedial design project manager for a Superfund site with PCB- and VOC-containing soil and groundwater. Responsible for directing design activities to complete plans and specifications for the excavation and treatment of soil and groundwater. The soil treatment component involved both incineration and solvent extraction, and included participating in a Superfund Innovative Technology Evaluation (SITE) Program Demonstration for a solvent extraction process.

Wells G&H Superfund Site, Woburn, MA. FS lead for the river study component of this project. Responsible for identifying and evaluating remedial technologies to support the development of remedial alternatives for sediment in the Aberjona River.

Nyanza Chemical Superfund Site, Ashland, MA. FS lead for a 35-acre property historically occupied by several dye manufacturing companies. Directed the feasibility study to evaluate the overburden and shallow bedrock aquifers containing a mixture of VOCs, SVOCs, and heavy metals.

Previously was the manager of laboratory testing and services at Haley & Aldrich, Inc. Responsible for overall operation and management of the laboratory providing physical and chemical testing of soils, data analysis and interpretation services, and bench-scale testing for FSs.

Developed and implemented a bench-scale testing program to optimize design parameters for a low-permeability cap, constructed primarily with free-draining soils. The low permeability was achieved by using a proprietary bentonite mixture under optimal conditions. These conditions were determined through a comprehensive bench-scale testing and evaluation program that examined a wide range of mixing ratios for the propriety bentonite, free draining soils, and water content.

Designed and implemented testing programs for clay materials that were to be used to cap and/or line hazardous waste and municipal landfills. The programs also included construction QC testing of the clay materials during and following placement.

Worked for several construction companies in New England including Modern Continental Construction, Slattery Construction, and Morse Diesel Construction.

Publications and Presentations:

C.R. Barnes, C.S. Koll and A.S. Fowler. 2002. Delineation of Volatile Organic Compounds in Stream Bottoms by Passive Vapor-Diffusion Samplers. *Poster Presentation for the Sediment Management Seminar 2002.*

K. Lukasiewicz, A. Fowler, S. Perry, M. Eves, R. Houck and R. Mohan. 2002. Lake Okeechobee Sediment Management Feasibility Study. *Poster Presentation for the Sediment Management Seminar 2002.*

Hattersley, M., M. Shivell, and A.S. Fowler. 2000. GIS – An Effective Tool for Management of Sediment Sites. *Poster Presentation for the Sediment Management Seminar 2000.*

Fowler, A.S. and R.J. Gleason. November 6-7, 1997. Developing Common Sense Remedial Solutions For the New Bedford Harbor Superfund Site. *Strategic Environmental Management Using Risk-Based Approaches Seminar,* Las Vegas, Nevada.

Doward-King, E.J., R.J. Kadeg, A.S. Fowler. and S. Pavlou. 1992. Use of Risk Assessment, Risk Management, and Engineering/Economic Feasibility Analysis in

Remedial Decision Making for Contaminated Soils. *Risk Assessment/Management Issues in the Environmental Planning of Mines*, pp. 63-66.

Fowler, A.S. and M.R. Hanson. June 16-21, 1991. Ambient Air Monitoring of Dredging and Disposal of PCB Contaminated Sediment at a Marine Superfund Site: New Bedford Harbor, Massachusetts. *84th Annual Meeting & Exhibition of the Air and Waste Management Association*, Vancouver.

Phelps, D.K., D.J. Hansen, J.K. Scott, and A.S. Fowler. 1988. Monitoring Program in Support of the Pilot Study of Dredging and Dredged Material Disposal Methods, New Bedford, Massachusetts Superfund Site. *HMCRI's 9th National Conference and Exhibition.*

ROUX **Professional Profile**

Lawrence McTiernan, PG, LSP
Principal Hydrogeologist

Technical Specialties:
Management of environmental investigations and remedial actions at hazardous waste sites, including CERCLA, RCRA, and MCP sites; Regulatory negotiations; Litigation Support; ASTM Phase I and II site assessments and EPA All Appropriate Inquiries standard; Support for property acquisitions/divestitures; Sedimentary geology and sediment transport.

Experience Summary:
16 years of experience: Principal, Senior, Project and Staff Hydrogeologist with Roux Associates

Credentials:
B.A. Geology, Lafayette College, 1987
M.S. Marine Environmental Sciences, State University of New York at Stony Brook, 1989
Professional Geologist, Pennsylvania, 1995
Licensed Site Professional, Massachusetts, 2005

Professional Affiliations:
National Ground Water Association
Licensed Site Professional Association

Key Projects:

- Project Manager and then Principal-in-Charge for ongoing Remedial Investigation at the Industri-Plex Superfund Site in Woburn, Massachusetts (No. 5 on the original NPL). Site contains VOCs and metals in soil, groundwater, surface water, and sediment. Major activities have included the following: technical impracticability (TI) demonstration involving evaluation of historical site groundwater data, modeling groundwater and contaminant flow systems and various pump-and-treat scenarios, and demonstrating the TI of achieving ROD IRM cleanup objectives for groundwater via pump and treat; preliminary intrinsic remediation demonstration involving collection of data to demonstrate that benzene, toluene, arsenic, and chromium groundwater plumes are being attenuated through intrinsic processes within the aquifer and within wetland sediments; source-area investigations that included geophysical surveys and Geoprobe sampling of soil gas, soil and groundwater; a pond/wetland sediment transport/remobilization study involving automated sampling of surface-water inflows and discharges during baseflow and storm conditions; vertical profiling of groundwater quality along 16 multi-point sampling transects; Geoprobe sampling of a buried former lakebed; negotiation and preparation of work plans and Project Operations Plans (FSP, QAPP, HASP); and general agency negotiations.

- Principal-in-Charge for 25-site portfolio of retail service station investigation and remediation projects for major New England petroleum distributor/retailer. Projects included assessment and remediation at active and former retail service stations and construction oversight for UST closures and service station renovations.

- Principal-in-Charge for Interim Groundwater Monitoring Program at Stamina Mills Superfund Site in North Smithfield, Rhode Island. Project included low-flow sampling of multi-zonal bedrock wells and sampling of several residential wells, and was being performed in conjunction with dual-phase SVE remediation of source zone and shallow overburden being performed by others.

- Project Manager and then Principal-in-Charge for Groundwater Remedy at the Fulton Terminals Superfund Site in Fulton, New York. Site groundwater was impacted by chlorinated VOCs. Negotiated and implemented an Expedited Pumping Program (EPP) as an alternative to ROD-specified groundwater remedy. EPP involved short-term (12 weeks) pump-and-treat using mobile system and an existing on-site well, periodic sampling of groundwater, and modeling of post-pumping natural attenuation of residual groundwater impacts. Project also included geophysical survey to determine extent and decay rate of freezewall (Soil Remedy) remnants that delayed complete attenuation of groundwater contamination. Successfully argued, based on success of EPP, that additional active remediation of site groundwater was not necessary, and won EPA approval to prepare Construction Completion Report. NYSDEC has downgraded the site from Class 2 to Class 4. Currently performing Long-Term Groundwater Monitoring Program to monitor residual VOC concentrations at two downgradient wells which marginally exceed standards.

- Project Manager for a supplemental remedial investigation at the Pollution Abatement Service (PAS) Superfund Site in Oswego, New York (No. 7 on the original NPL). Site contains VOCs, metals, pesticides, and PCBs in soil, groundwater, surface water, and sediment. Project involved delineating a plume of VOCs in bedrock groundwater, evaluating effectiveness of bedrock pumping to restore bedrock groundwater quality, evaluating potential impacts of bedrock pumping on effectiveness of existing overburden groundwater containment system, delineating the extent of pesticides and PCBs in adjacent creeks and wetlands, identifying potential upstream sources of pesticides and PCBs, and evaluating potential engineering improvements to existing cap/containment system. Successfully demonstrated technical impracticability of bedrock pump-and-treat remedy selected in ROD, resulting in EPA's issuance of an ESD; successfully linked upstream sources to sediment PCB contamination at site; and successfully demonstrated that site is not the source of PCBs in nearby wetland. Latter two demonstrations led to No Further Action ROD for wetland sediments. Also assisted in negotiating of new consent order which relaxed long-term pumping and monitoring requirements.

- Project Manager for RCRA corrective action program at a 100+ year-old former manufacturing site in southeastern Massachusetts. Site contains chlorinated solvents, metals, and cyanide in soil, groundwater, surface water, and/or sediment. To date, project has involved deep bedrock coring (including angled drilling); evaluation for DNAPL; additional well installation; sampling of groundwater, surface water, sewers, soil gas and indoor air; imminent hazard evaluations, and soil-vapor intrusion modeling. Performed limited feasablity study for stabilization measures to address hot-spot soils. Successfully demonstrated additional source for downgradient contamination. Assisting client in marketing and sale of property.

- Project Manager for MCP reponse actions at an active petroleum bulk storage terminal in western Massachusetts. Project has included Phase V operation & maintenance of an air-sparge/SVE system and post-remediation assessment of soil and groundwater quality. Currently evaluating potential for site closure.

Lawrence McTiernan, PG, LSP
Principal Hydrogeologist

- Project Manager for MCP Response Actions at a large active industrial facility in northeastern Massachusetts with multiple releases/RTNs. Site soils and groundwater are impacted mainly by chlorinated VOCs, but also by cyanide, ammonia, and metals. Completed supplemental Phase II Comprehensive Site Assessment activities for a historic Tier IB release including additional contaminant delineation, evaluating potential contributions from an upgradient property, and evaluated the efficiency of existing remediation systems. Performed Phase I Initial Site Investigation activities and prepared Tier Classification Submittal (Tier IC) for a newer release. Conducted preliminary assessment of third release discovered during due diligence activities, including SRM Evaluation due to proximity of surface water. Also assisted client with property transactional issues, including due diligence, deed restrictions, future liability issues, and access needs.
- Project Manager for supplemental Phase II Comprehensive Site Assessment activities at a retail service station in northeastern Massachusetts. Developed closure strategy to "risk away" exceedences of MCP Method 1 Standards using Method 2 approach. Successfully demonstrated that Method 1 GW-2 and GW-3 Standards for VPH fractions did not apply at site based on evidence for limited vapor-phase migration and absence of VPH at sentinel well combined with declining post-soil remedy source-area concentrations. Prepared Method 2 Risk Characterization and Response Action Outcome.
- Project Manager for MCP response actions required for a release of petroleum hydrocarbons adjacent to a subsurface interstate petroleum transmission pipeline. Project activities have included Phase I Initial Site Investigation activities, Tier Classification (Tier II), and scoping of preliminary Phase II Comprehensive Site Assessment activities designed to delineate the extent of impacts and evaluate potential sources of contamination.
- Project Manager for a litigation support project at a site in New York City with groundwater impacted by PCE. Project involved reviewing and evaluating data developed by opposing side's consultant, performing a limited field investigation, and producing a report demonstrating the likelihood of an off-site source of the PCE in groundwater beneath the site. Entered into "investigation-only" voluntary cleanup program agreement with NYSDEC, through which a No Further Action certification was achieved, resulting in favorable settlement of litigation. NYSDEC later identified and confirmed nearby off-site source of PCE.
- Project Manager for NCP-compliant remedial investigation (RI) at a manufacturing facility in Pennsylvania. Site contained chlorinated solvents in soil and groundwater. RI involved source-area identification; delineation of the extent of impacted media through soil gas, soil, and groundwater sampling; and evaluation of contaminant fate and transport, including slug testing and analysis.
- Project Manager for a pre-design investigation conducted in support of a constructed wetland remedy at a manufacturing plant in tidewater Virginia. Project involved evaluating existing data, scoping and implementing a limited investigation designed to improve the understanding of site hydrogeology, and calculating flux of metals of concern to groundwater discharge areas.
- Project Manager during decommissioning of a manufacturing facility in Rhode Island. Project included due diligence site assessment, UST closure, decontamination of indoor areas containing metals-laden dust, and production-well abandonment.
- Project Manager for development of a remedial investigation work plan at a state Superfund site in a karstified area of Tennessee. Site contained VOCs and SVOCs, metals, and pesticides in soil, groundwater, surface water, and sediment. As part of work plan development, reviewed existing hydrogeologic data and conducted preliminary karst evaluation. Also coordinated implementation of cap-repair IRM.
- Project Manager for NCP-compliant Phase 2 remedial investigations at five manufacturing facilities in Pennsylvania and North Carolina. Sites contained VOCs and PCBs in soil, groundwater, and sediment. Projects involved completing delineation of the extent of impacted media to support an FS and risk assessment at each site.
- Project Manager for Phase II investigations at seven car dealerships on Long Island, New York. Each Phase II involved a review of previous consultants' Phase I reports, Geoprobe soil and groundwater sampling, and review of agency files for several adjoining properties.
- Project Manager for a hydrogeologic investigation at a landfill site in West Virginia, in connection with landfill expansion permitting. Responsibilities also included assistance in preparation of state Part I and Part II permit applications.
- Project Manager for over 25 Phase I property transfer site assessments throughout New York and New England.

Alternative Remedial Action Plan

Multiple Source Groundwater Response Plan Study Area

Woburn, Massachusetts

August 31, 2005

Prepared For:

Pharmacia Corporation (f.k.a. Monsanto Company)
By its Attorney-in-Fact
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1.0 Alternative Remedial Action Summary

Protection of public health and the environment would be achieved in a more protective and effective manner if the following Alternative Remedial Action was to be implemented instead of USEPA's Proposed Plan:

Media	Location	Alternative Remedial Action
Surface and Subsurface Soil	Former Lake Mishawum	Institutional controls to restrict access to surface and subsurface soils
		Long-term groundwater monitoring
Groundwater	Halls Brook Holding Area Pond	Permeable subaqueous reactive cover over existing sediments in the bottom of HBHA Pond to sorb arsenic as groundwater discharges to surface water
		Long-term groundwater monitoring
	West Hide Pile	Institutional controls to restrict groundwater use
Sediments	Halls Brook Holding Area Pond	Flow controls to increase sediment deposition
		Long-term sediment monitoring
	Halls Brook Holding Area Wetland	Flow controls to increase sediment deposition
		Institutional controls to restrict access to sediments
	Wells G&H Wetland and Cranberry Bog Conservation Area	In-situ capping to prevent exposure to near-shore sediments
		Biological barriers (thorn bushes) to limit access to deep water sediments
	Wells G&H Wetland - Deep Areas	Institutional controls to restrict access to deep water sediments
Surface Water	Halls Brook Holding Area	Long-term surface-water monitoring

Institutional controls would be implemented on those properties located within the boundaries of former Mishawum Lake with concentrations above appropriate risk-management levels to restrict access to arsenic-containing soils. Massachusetts Contingency Plan (MCP) Activity and Use Limitations (AULs) would be used to implement these institutional controls.

A permeable, subaqueous reactive cover, consisting of sand, or other granular material, and reactive iron, would be installed in HBHA Pond on top of existing sediments to supplement the arsenic-removal capacity of the these sediments. Arsenic migration control would be achieved by sorption of arsenic on iron-rich sediments beneath the reactive cover and reactive iron in the permeable subaqueous cover as arsenic-containing groundwater discharges to surface water in HBHA Pond. Long-term monitoring of sediments in HBHA Pond would be performed to assess the arsenic sorption capacity of the reactive cover.

Migration of sediments from Halls Brook Holding Area would be controlled by installing flow control structures and devices in HBHA Pond and Wetland to decrease surface water flows and increase sediment deposition, thereby decreasing the Total Suspended Solids (TSS) flux from Halls Brook Holding Area. These actions would remove up to 85 percent of the TSS generated in runoff from a 100 year storm. HBHA Wetland enhancement would create new benthic invertebrate habitats and also result in significant improvements in wetlands species diversity, wildlife habitat and hydrologic function through supplemental planting and hydraulic modifications. Long-term surface water monitoring would be performed at the outlet of HBHA to determine arsenic flux under storm and non-storm conditions.

Capping near-shore sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area would isolate these sediments in place in a manner that would prevent human exposure. Installation of these caps would create upland islands that would increase habitat diversity within the existing wetland systems. Capped areas would be re-vegetated with plants inhospitable to humans to create natural biological barriers to the capped areas and deter access to deep sediments in the interior of the wetland. Capping would add to the mosaic of habitats present in this riparian system, providing new habitat types and increased habitat edges and assure long-term protection of human health and the wetland ecosystem. Institutional controls would be implemented as MCP AULs to restrict access to deep water sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area.

Institutional controls, which are ready to be inaugurated, would be used to restrict groundwater use at the West Hide Pile. MCP AULs would be used to restrict groundwater use on those other portions of the Study Area where arsenic and benzene are migrating in groundwater toward and discharging to HBHA Pond.

2.0 Development of Alternative Remedial Action

Soil - This component of the Alternative Remedial Action does not involve treatment or removal, it does provide protection of public health and the environment by controlling potential exposures to soils with concentrations greater than appropriate risk-management levels through implementation of institutional controls. Institutional controls that would be implemented include prohibitions on the use of impacted properties for a day care facility, and prohibitions on excavation without regulatory oversight and adequate health and safety precautions (engineering controls, personal protective equipment, etc.) to minimize or prevent direct contact with impacted soil during removal activities and control potential on-site and off-site spread of impacted soil.

Institutional controls would be implemented to prevent future exposures to soils in the former Mishawum Lake bed area with arsenic concentrations greater than appropriate risk-management levels. The primary components of this portion of the Alternative Remedial Action would include:

- **Conducting a pre-design investigation to delineate the limits of soil above appropriate risk-management levels so that properties requiring institutional controls may be identified;**
- **Mobilization and demobilization of required personnel and equipment to conduct property surveys;**
- **Coordination with local, state and federal agencies and property owners to develop property-specific deed restriction documents;**
- **Filing of deed restrictions and/or other appropriate institutional controls and providing a long-term maintenance program;**
- **Long-term inspections to ensure that the deed restrictions are being enforced;**
- **Long-term monitoring of groundwater to evaluate constituent of concern status and migration; and**
- **Performance of 5-year reviews to monitor the effectiveness of the remedy.**

Institutional controls, implemented as MCP AULs would take the form of land-use restrictions, specifically the prohibition of use by a day care facility, and prohibitions on excavation in this area, including paved areas and below building foundations, unless adequate precautions (engineering controls, personal protective equipment, etc.) were taken to minimize or prevent direct contact with impacted soil during removal activities. These types of controls would be designed to address potential human health risks from exposure to surface and subsurface soils in the former Mishawum Lake bed area with concentrations above appropriate risk-management levels. This remedial action does not involve any actions that will reduce the toxicity, mobility or volume of impacted soil. The only on-site activities that would be conducted under this remedial action are long-term groundwater monitoring and periodic reviews of site conditions and risks. A review of site conditions and risks would be conducted every five years since impacted soils would remain on site above levels that allow for unlimited use and unrestricted exposure.

Groundwater - This component of the Alternative Remedial Action involves reduction in mobility and toxicity through treatment, provides protection of public health by preventing or controlling potential exposures to groundwater through institutional controls and protects the environment by preventing benthic invertebrates from contacting impacted sediments and surface water. Migration of impacted groundwater to HBHA Pond, and Wetland and then downstream as surface water to the Aberjona River, would be controlled by intercepting it in HBHA Pond where natural processes, which would be enhanced with iron-containing minerals or media, are currently degrading or sequestering the constituents of concern such that no unacceptable human health or ecological risks are present downstream of the Pond. The primary components of this portion of the Alternative Remedial Action would include:

- **Coordination with local, state and federal agencies and property owners to design and construct a permeable subaqueous reactive cap;**
- **Mobilization and demobilization of required personnel and equipment to the site for construction of the permeable subaqueous reactive cap;**
  - **Limited clearing and grubbing for equipment and materials laydown areas;**
  - **Installation of silt curtains, sedimentation booms and other equipment; and**
  - **Placement of cap materials through the water column**
- **Long-term inspections and maintenance of the cap to ensure erosional forces have not deteriorated the cap's thickness thus reducing its effectiveness;**
- **Coordination with local, state and federal agencies and property owners to develop property-specific deed restriction documents;**
- **Mobilization and demobilization of required personnel and equipment to conduct property surveys and conduct periodic sampling;**
- **Filing of deed restrictions and/or other appropriate institutional controls and providing a long-term maintenance program;**
- **Long-term inspections to ensure that the deed restrictions are being enforced;**
- **Long-term monitoring of groundwater and sediment to evaluate constituent of concern status and migration; and**
- **Performance of 5-year reviews to monitor the effectiveness of the remedy.**

Installing a permeable subaqueous cover over the entire bottom of HBHA Pond would contain the existing sediments in place and preserve the sorptive capacity of the existing sediments, which are effectively removing arsenic from groundwater as it discharges to the Pond. Addition of reactive material to the cover will provide additional control of the discharge of arsenic to surface water via the groundwater pathway by sorbing arsenic to the reactive material. Natural iron-containing minerals (magnetite, taconite, etc.) or designed media (Zero Valence Iron (ZVI), Granular Ferric Oxides, etc.) are effective sorptive material to include in the sand cover. A sand or other granular material/reactive iron cover would be placed through the water column on top of a geogrid installed on the surface of existing sediments. Arsenic would be sorbed to the reactive iron as groundwater migrates through the permeable reactive cover and discharges to surface water. This permeable reactive cover would keep arsenic out of the iron hydroxide floc that forms at the oxic/anoxic boundary in HBHA Pond.

Human health risks and hazards above risk management criteria from direct contract with impacted groundwater could result from future use of site groundwater as industrial process water or as wash water in a car wash. Institutional controls, implemented as MCP AULs or grants of environmental restriction for those portions of the MSGRP Study Area outside of the Industri-Plex Superfund Site where arsenic and benzene are migrating in groundwater toward HBHA Pond, could limit human exposure to impacted groundwater through restrictions that would prohibit the use of site groundwater for activities that would pose a future human health risk. Since the Custodial Trust owns the property on which the West Hide Pile is located, implementation of restrictions on groundwater use could be readily accomplished through institutional controls that are ready to be inaugurated.

This remedial action at the West Hide Pille does not involve any actions that will reduce the toxicity, mobility or volume of impacted groundwater although it is important to note that benzene concentrations in groundwater, the risk driver at the West Hide Pile, decreased from 63,000 ug/l in 1991 to 4,800 ug/l in 2002. Long-term monitoring is not appropriate because groundwater concentrations of benzene are less than the 7,000 ug/l MCP GW-3 standard for groundwaters discharging to surface water. The only on-site activities that would be conducted under this remedial action are periodic reviews of site conditions and risks. A review of site conditions and risks would be conducted every five years since impacted groundwater would remain on site above levels that allow for unlimited use and unrestricted exposure.

Sediments - This component of the Alternative Remedial Action provides reduction of mobility through treatment, provides protection of the environment by preventing migration of impacted sediments to downstream areas and creates new benthic habitat and higher value wetlands. The primary components of this portion of the Alternative Remedial Action would include:

- **Coordination with local, state and federal agencies and property owners to design and construct flow control structures and devices;**
- **Mobilization and demobilization of required personnel and equipment to HBHA for construction of the flow control structures and devices;**
  - **Limited clearing and grubbing for equipment and materials laydown areas;**

  - Installation of silt curtains, sedimentation booms and other equipment to prevent downstream migration of sediments during construction and placement of flow control structures and devices;
  - Construction of four low-head dikes, one at the outlet of HBHA Pond and three in HBHA Wetland;
  - Construction of storm-water flow deflector at Halls Brook;
  - Construction of a low-head dike with spillway, plunge pool and apron at Atlantic Avenue Drainway;
  - Construction of a headwall at the ephemeral tributary draining ROW No. 9;
  - Installation of silt curtains in HBHA Pond;
  - Construction of natural flow deflectors in HBHA Wetland;
  - Creation of approximately 1 acre of new benthic habitat;
  - Enhancement of approximately 2 acres of existing HBHA wetlands into higher value wetlands through increased vegetation diversity, new mircopool habitat areas and improved hydrologic function; and
  - Construction of a micropool at the downstream end of HBHA Wetland.

- Long-term inspections and maintenance of the low-head dikes, flow deflectors, headwall, plunge pools, aprons and silt curtains to ensure hydraulic forces have not impacted performance and reduced effectiveness of the enhanced HBHA;
- Coordination with local, state and federal agencies and property owners to design and construct near-shore sediment caps in the Wells G&H Wetland and Cranberry Bog Conservation Area;
- Mobilization and demobilization of required personnel and equipment to the Wells G&H Wetland and Cranberry Bog Conservation Area for construction of the near-shore sediment caps;
  - Limited clearing and grubbing for equipment and materials laydown areas;
  - Installation of silt curtains, sedimentation booms and other equipment to prevent downstream migration of sediments during cap placement; and
  - Construction and vegetation of in-situ caps.
- Long-term inspection and maintenance at the Wells G&H Wetland and Cranberry Bog Conservation Area to ensure that erosional forces have not deteriorated the cap's thickness thus reducing its effectiveness;
- Coordination with local, state and federal agencies and property owners to develop property-specific deed restriction documents;
- Mobilization and demobilization of required personnel and equipment to conduct property surveys in each wetland;
- Filing of deed restrictions and/or other appropriate institutional controls and providing a long-term maintenance program for each impacted wetand;
- Long-term inspections to ensure that the deed restrictions are being enforced;
- Long-term monitoring of surface water to evaluate constituent of concern status and migration; and

- **Performance of 5-year reviews to monitor the effectiveness of the remedy.**

Installing flow control structures and devices in HBHA Pond and Wetland would decrease surface water flows and increase sediment deposition, thereby decreasing Total Suspended Solids (TSS) flux from Halls Brook Holding Area (Figure 1). In HBHA Pond, a low-head dike with spillway, plunge pool and riprap apron would be constructed at the Atlantic Avenue Drainway confluence, a flow deflector would be constructed at the Halls Brook confluence and a headwall would be constructed at the confluence of the ephemeral stream that enters the Pond just south of NStar Right of Way (ROW) No. 9. In addition, flow deflectors and floating silt curtains would be installed in the Pond and a low head dike, plunge pool and riprap apron would be installed at the Pond outlet. Three low head dikes would be installed in HBHA Wetland to create, from upstream to downstream, a low marsh cell, a high marsh cell, a low marsh cell, all with isolated micropools, and a large terminal micropool downstream of the last cell to reduce flow velocities and increase sediment deposition. Natural earthen flow deflectors would be installed in each of the cells and in the micro pool to enhance sediment deposition. These actions would remove up to 85 percent of the TSS generated in runoff from a 100 year storm. The proposed modifications to the wetlands would create new benthic invertebrate habitat in the micropools. The wetlands enhancements would also result in significant improvements in wetlands species diversity, wildlife habitat and hydrologic function through supplemental planting and hydraulic modifications.

Capping near-shore sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area would isolate these sediments in-place in a manner that would prevent human exposure and erosion and downstream transport of these sediments. Placement of clean fill, compatible with native wetland soil, over the existing sediments would both isolate the sediments and provide a substrate for restoration of the wetland. An effective cap could be designed that would serve as a dermal barrier to recreational receptors and also satisfy the preferred restoration goals for the near-shore wetland areas. Installation of caps would create upland islands that would increase habitat diversity within the existing wetland systems. Re-vegetation of capped areas can also be used to create natural "biological barriers" to prevent, or discourage, access to deep sediment areas in the Wells G&H Wetland. Many plant species present are inhospitable for humans, and re-vegetation of capped areas would incorporate such plants to provide biological barriers to deter access to deep sediments in the interior of the wetland. Indigenous (i.e., native) species from various vegetative strata (e.g. trees, shrubs and vines) are recognized as inhospitable or nuisance species by most recreational users, such as hawthorn, a tree with large thorns on branches and twigs, and cat briar, a dense-growth vine with briars along its stem. Capping would add to the mosaic of habitats present in this riparian system, providing new habitat types and increased ecotones (i.e., habitat edges) and assure long-term protection of human health and the wetland ecosystem. Although the proposed capping and re-vegetation would enhance the habitat value and overall wetland function, any potential loss of wetlands in the Wells G&H and Cranberry Bog Conservation Area as a result of grade elevation (approximately 1 acre total to be capped) would be mitigated by proposed actions in the HBHA Wetland:

- **Creation of approximately 1 acre of new benthic habitat; and**
- **Enhancement of approximately 2 acres of existing HBHA wetlands into higher value wetlands through increased vegetation diversity, new micropool habitat areas and improved hydrologic function.**

Institutional controls, implemented as MCP AULs, would only apply to the deeper sediment sample locations (sediment core sample areas) in the interior portions of the HBHA Wetland and the Wells G&H Wetland. Under this remedial action, institutional controls would be implemented to prevent future exposures to impacted sediment in the vicinity of the sediment core sample areas where potential human health risks and hazards above risk management criteria were identified. Institutional controls would take the form of prohibitions on dredging or excavation in the interior wetland areas unless adequate precautions (e.g. engineering controls, personal protective equipment, etc.) were taken to minimize or prevent direct contact with impacted sediment removed as part of maintenance dredging. These controls would be designed to address the potential human health risks and hazards that were identified under the future dredger scenarios for the HBHA and Wells G&H wetlands. Institutional controls do not involve any actions that will reduce the toxicity, mobility or volume of impacted sediments. The only on-site activities that would be conducted are periodically reviewing site conditions and risks. A review of site conditions and risks would be conducted every five years.

Monitoring - By adapting an integrated approach to site monitoring, monitoring efforts could be focused on arsenic-containing and benzene-containing groundwater discharging from the Industri-plex Superfund Site to surface water in Halls Brook Holding Area Pond, arsenic accumulation in HBHA Pond sediments, the potential for arsenic-containing groundwater from Former Lake Mishawum to discharge into HBHA Wetland and arsenic flux from Hall Brook Holding area wetland via the surface water pathway (Figure 2). Groundwater discharge from the site would be monitored by installing three well clusters at the north end of HBHA Pond to determine whether or not arsenic concentrations were increasing, decreasing or steady state. Sampling would be conducted quarterly for two years, semiannually for three years and annually thereafter. Sediment sampling would be performed annually at three locations in HBHA Pond (upstream end, center and downstream end) to determine the amount of arsenic sorbed to the sediments and the amount of sorption capacity remaining. Three monitoring well clusters would be installed on the eastern edge of HBHA Wetland to determine if arsenic was mobilized from buried lake bottom sediment and migrating to the wetland. One well cluster would be located at the north end of HBHA Wetland, one well cluster would be located in the center of the wetland and the other well cluster would be located at the south end of the wetland. Sampling would be conducted semiannually for five years, annually for five years and discontinued if arsenic is not discharging to surface water at concentrations that would cause an adverse impact on public health or the environment. To determine arsenic flux from HBHA Wetland, a surface water sampling station would be maintained at the outlet of the wetland to sample monthly baseflow and storms with greater than 0.5 inches of precipitation. Samples would be analyzed for TSS and Total and Dissolved Arsenic.

3.0 Detailed Analysis of Alternative Remedial Action

The Alternative Remedial Action that was developed in Section 2.0 is analyzed in detail in this section. The detailed analysis of the alternative provides information to facilitate selection of a specific remecy or combination of remedies. The detailed analysis of this alternative was developed in accordance with the NCP (40 CFR 300.430(e)) and the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, Oct 1988).

3.1 Evaluation Criteria

In conformance with the NCP, seven of the following nine criteria were used to evaluate each of the Alternative Remedial Action during the detailed analysis. The last two criteria, state and community acceptance, were not addressed because they require state and public comments on the RI/FS.

- **Overall Protection of Human Health and the Environment**
- **Compliance with ARARs**
- **Long-Term Effectiveness and Permanence**
- **Reduction of Toxicity, Mobility, or Volume Through Treatment**
- **Short-Term Effectiveness**
- **Implementability**
- **Cost**
- **State Acceptance**
- **Community Acceptance**

Under the NCP, the selection of the remedy is based on the nine evaluation criteria, which are categorized into three groups:

- **Threshold Criteria - The overall protection of human health and the environment, and compliance with ARARs are threshold criteria that each alternative must meet in order to be eligible for selection.**

- **Primary Balancing Criteria - The five primary balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.**

- **Modifying Criteria - The state and community acceptance are modifying criteria that will be considered in remedy selection.**

Brief, general discussions of these evaluation criteria are presented in the following text. Detailed analyses of the Alternative Remedial Action using these evaluation criteria are presented in Section 3.2. The comparative analysis of the remedial alternatives is presented in Section 4.0.

3.1.1 Overall Protection of Human Health and the Environment

This evaluation criterion provides a final check to assess whether or not each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria including: long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The evaluation focuses on whether or not a specific alternative achieves adequate protection and how risks are eliminated, reduced, or controlled, and whether Remedial Action Objectives (RAOs) would be achieved.

3.1.2 Compliance with ARARs

ARARs are considered during the detailed evaluation of alternatives. Alternatives are assessed on whether or not they attain ARARs. When an ARAR cannot be met, the basis for justification of a waiver under CERCLA, or within the specific requirement, is presented. The actual determination of which ARARs are requirements is made by USEPA in consultation with the MDEP.

31.3 Long-Term Effectiveness and Permanence

Under this criterion, the alternatives are evaluated for long-term effectiveness, permanence, and the degree of risk remaining after the RAOs have been met. The following components are evaluated:

- Magnitude of residual risks - Assesses the residual risk remaining from untreated wastes or treatment residuals at the conclusion of remedial actions, the remaining sources of risk, and the need for 5-year reviews.

- Adequacy and reliability of controls - assesses controls that are used to manage treatment residuals or remaining untreated wastes. This assessment includes addressing: the likelihood of technologies to meet required efficiencies or specifications, type and degree of long-term management, long-term monitoring requirements, operation and maintenance (O&M) functions to be performed, uncertainties associated with long-term O&M, potential need for replacement of technical components and associated magnitude of risks or threats, degree of confidence in controls to handle potential problems, and uncertainties associated with land disposal of untreated wastes and residuals.

3.1.4 Reduction of Toxicity, Mobility or Volume through Treatment

This criterion addresses the statutory preference for remedies that employ treatment as a principal element by assessing the relative performance of different treatment technologies for reducing the toxicity, mobility, or volume of the contaminated media. Specifically, the analysis should examine the magnitude, significance, and irreversibility of the estimated reductions.

The degree to which remedial alternatives employ treatment that reduces toxicity, mobility, or volume is assessed by considering the following factors:

- The treatment processes that the remedies employ, the media they would treat, and threats addressed;
- The approximate amount of hazardous materials that would be destroyed or treated;
- The degree of expected reduction in toxicity, mobility, or volume as a result of treatment;
- The degree to which the treatment is irreversible;
- The type and quantity of residuals that would remain following treatment, considering the persistence, toxicity,

mobility, and bioaccumulation capacity of the contaminants of concern and impacted media, and

- The ability of alternatives to satisfy the statutory preference for treatment as a principal element.

3.1.5 Short-Term Effectiveness

The assessment of short-term effectiveness during construction or implementation until the RAOs are met includes consideration of the following factors:

- Potential short-term impacts to the community during remedial actions and whether risks may be addressed or mitigated;
- Potential impacts to, and protection of, the workers during remedial actions;
- Potential adverse environmental impacts that result from construction and implementation of the alternative, and the reliability of mitigation measures, and
- Time until RAOs are achieved.

3.1.6 Implementability

The ease or difficulty of implementing a remedial alternative is assessed by considering the following factors during the detailed analysis:

- Technical Feasibility:
  - Degree of difficulty or uncertainties associated with constructing and operating the alternative;
  - Technical difficulties associated with the technologies' reliability that could result in schedule delays;
  - Likelihood of additional remedial actions and anticipated ease or difficulty in implementation, and
  - Ability to monitor the effectiveness of the remedy and risks of exposure if monitoring is insufficient to detect remedy failure.
- Administrative Feasibility:
  - The need to coordinate with other offices and agencies, and obtain necessary approvals and permits.
- Availability of Services and Materials:
  - Availability of adequate capacity and location of treatment, storage, and disposal services, if required;
  - Availability of necessary equipment and specialists;
  - Availability of treatment technologies comprising the alternative, sufficient demonstration of the technologies, and availability of vendors, and
  - Availability of services and materials, and the potential for obtaining competitive bids.

3.1.7 Cost

A detailed cost analysis is performed for each alternative to assess the net present worth cost to implement the remedial actions. The cost analysis consists of the following:

- Estimation of capital (direct and indirect) and annual O&M costs;
- Development of costs with an accuracy in the range of plus 50 percent to minus 30 percent, and
- Calculation of the present worth (capital and O&M costs) of the alternative by discounting to a base year or

current year using a discount rate of seven percent.

3.2 Detailed Analysis of Alternative

The following sections provide a detailed analysis of the proposed Alternative Remedial Action. The analysis evaluates the different components (soil, groundwater, sediments and surface water) of the proposed Alternative Remedial Action against each criterion.

3.2.1 Overall Protection of Human Health and the Environment

Implementation of the Alternative Remedial Action will results in achievement of all applicable RAOs.

Soil – This component of the Alternative Remedial Action is consistent with the USEPA's Proposed Plan. While this component of the Alternative Remedial Action does not involve treatment or removal, it protects public health and the environment by controlling potential exposures to soils with concentrations greater than appropriate risk-management criteria through implementation of institutional controls. Prohibitions on the use of impacted properties for a day care facility would be implemented to prevent future exposures to soils with arsenic concentrations greater than appropriate risk-management criteria. Prohibitions on excavation without regulatory oversight and adequate health and safety precautions (i.e., engineering controls, personal protective equipment, etc.) would be implemented to minimize or prevent construction worker contact with soils in the former Mishawum Lake bed area containing arsenic concentrations greater than appropriate risk management criteria. Groundwater will be monitored to verify soil to groundwater migration has been adequately controlled.

Groundwater – Without remedial action, human health risks and hazards above risk management criteria from direct contact with impacted groundwater could result from future use of site groundwater at the West Hide Pile as industrial process water, or as wash water in a car wash. Addressing groundwater as proposed in the Alternative Remedial Action provides protection of public health through institutional controls, specifically deed restrictions that would implement the existing Grant of Environmental Restriction (GER) to prohibit the use of site groundwater from the West Hide Pile area for industrial process water or car wash use.

Migration of impacted groundwater to HBHA Pond, where it discharges to surface water and creates the potential for benthic invertebrates to come into direct contact with impacted groundwater, would be controlled by intercepting it in HBHA Pond through the placement of a permeable subaqueous reactive cap. The reactive cap would use iron-containing minerals or media to enhance the ongoing natural processes of degradation and sequestration of the constituents of concern. Implementation of this groundwater Alternative Remedial Action would effectively treat groundwater discharging to surface water in the HBHA Pond through the sediments.

USEPA's preferred groundwater alternative does not consider nor take advantage of the beneficial natural sorptive capacity of the existing sediments to naturally treat groundwater discharging to HBHA Pond surface water. The enhanced groundwater treatment that would be provided by a reactive cap placed on existing sediments makes this Alternative Remedial Action for groundwater more protective of public health and the environment than USEPA's preferred alternative. In addition, USEPA's Proposed Plan, which bypasses Halls Brook during storm events, removes a source of natural iron-rich minerals and oxygenated surface water.

Sediments – This Alternative Remedial Action provides protection of human health and the environment by sequestering contaminated sediments within the HBHA Pond beneath a subaqueous permeable reactive cap, which would effectively treat dissolved-phase arsenic in groundwater (as discussed above) and in the sediments. The greatest concern associated with downstream migration of arsenic from the HBHA Pond should be resuspension and transport of iron hydroxide floc with adsorbed arsenic formed at the oxic/anoxic boundary rather than resuspension and transport of the very stable arsenic-containing sediments at the bottom of the pond. Under existing conditions surface water velocities within the Pond are too low to scour the pond-bottom sediments, even during storm flow. The low density iron hydroxide particles are more easily suspended than natural sediments, and their movement constitutes the primary downstream migration mechanism for arsenic. USEPA's preferred alternative for HBHA Pond sediments does not take into account that iron hydroxide floc and sorbed arsenic will not have enough time to settle in the proposed Sediment Retention Cell before water overflows to the Surface Water Polishing Cell and flows downstream. In addition, stormwater inflows from the Atlantic Avenue Drainway and the ephemeral stream from ROW No. 9 will re-suspend any settled floc and sweep it downstream during storm conditions. This Alternative Remedial Action addresses this important transport mechanism through inclusion of engineered flow controls to enhance sedimentation within the pond and the HBHA Wetland. The proposed construction of four low-head dikes would greatly reduce downstream migration of suspended particles, including arsenic-containing iron hydroxide floc, and, thereby, reduce risks.

Although USEPA has not demonstrated that, using reasonable exposure criteria, there is an actual human health impact due to the sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area, this proposed Alternative Remedial Action considers that capping will be used to control exposure to sediments in these areas. *In situ* caps would be placed over existing sediments in the Wells G&H Wetland and the Cranberry Bog Conservation Area to prevent recreational exposures to near-shore sediments with concentrations greater than appropriate risk management critieria. In addition to the dermal barrier protection provided by the caps, recreational exposures would be further prevented through re-vegetation of capped areas to create natural "biological barriers" to prevent, or discourage, walking on or through capped areas. In the Wells G&H Wetland, the re-vegetation would supplement the existing vegetation and conditions that currently limit recreational access to even near shore sediments.

Sediments in the deep areas of the HBHA and Wells G&H wetlands are not accessible to recreational visitors. Although construction of caps might elevate the grade in some remediated near shore areas, access would continue to be restricted through the re-vegetation of capped areas to create biological barriers to humans, while enhancing the riparian habitat diversity. Because arsenic concentrations above risk management criteria in deep sediments could pose a risk to future construction workers performing maintenance dredging within the HBHA and Wells G&H wetlands, the same institutional controls proposed by the USEPA for deep wetlands sediments are proposed in this Alternative Remedial Action.

Surface Water - The only unacceptable risk identified by USEPA for surface water was to benthic communities in the HBHA Pond due to exposure to arsenic and benzene in deep surface water. Monitoring will enable detection of any changes in surface water quality at HBHA Wetland outlet that could cause potential risks to the public or the environment.

3.2.2 Compliance with ARARs

Soil – The compliance with Applicable or Relevant and Appropriate (ARARs) for this Alternative Remedial Action for soils is consistent with USEPA's proposed plan, which also recommends institutional controls for surface and subsurface soils in the former Mishawum Lake bed.

Chemical-specific ARARs – There were no chemical-specific ARARs identified for surface or subsurface soils.

Location-specific ARARs – This alternative would comply with all applicable location-specific ARARs in Feasibility Study Tables 4-2B and 4-7B.

Action-specific ARARs – This alternative would comply with all applicable action-specific ARARs in Feasibility Study Tables 4-2A and 4-7A.

Other Criteria, Advisories, and Guidance – This alternative would comply with appropriate risk-management criteria for protection of human health from exposure to surface or subsurface soils in the former Mishawum Lake bed.

Groundwater – Because this Alternative Remedial Action employs institutional controls and a subaqueous permeable reactive cap in the HBHA Pond to effectively treat groundwater *in situ*, the evaluation of the groundwater remedy for compliance with ARARs is generally consistent with USEPA's Alternative GW-4, Plume Intercept By *In-Situ* Groundwater Treatment And Monitoring With Institutional Controls.

Chemical-specific ARARs – This alternative would comply with the chemical-specific ARARs in Feasibility Study Table 4-12C.

Location-specific ARARs – This alternative would comply with all applicable location-specific ARARs in Feasibility Study Table 4-12B.

Action-specific ARARs – This alternative would comply with all applicable action-specific ARARs in Feasibility Study Table 4-12A.

Other Criteria, Advisories, and Guidance – This alternative would comply with appropriate risk-management criteria for protection of human health from exposure to groundwater in the West Hide Pile area, and significantly reduce potential migration of arsenic downstream of the HBHA Pond originating from groundwater discharge into the pond through the sediments.

Sediment – This Alternative Remedial Action treats sediments in the HBHA Pond through placement of the subaqueous cap designed to treat groundwater *in situ*, addresses migration of sediments in the HBHA Pond and Wetland through construction of surface water flow controls (low-head dikes), addresses near shore sediments in the Wells G&H and Cranberry Bog Conservation Area wetlands through capping and re-vegetation to create biological barriers, and prevents exposure to deep wetland sediments through institutional controls. Thus, evaluation of this multi-component alternative for compliance with ARARs is generally consistent with USEPA's evaluations for Alternatives HBHA-3 Subaqueous Cap – Halls Brook Holding Area Pond Sediment and DS-2 Institutional Controls – Deep Sediment. A supplemental evaluation of compliance with ARARs for the proposed capping and re-vegetation to create biological barriers is included below, based on the ARARs compiled in the Feasibility Study for USEPA's preferred Alternative NS-4 Removal and Off-Site Disposal – Near-Shore Sediments.

Chemical-Specific ARARs – Placement of a subaqueous cap in the HBHA Pond would comply with relevant chemical-specific ARARs in Feasibility Study Table 4-15C. *In situ* capping and re-vegetation in Wells G&H and Cranberry Bog Conservation Area wetlands would comply with the pertinent chemical-specific ARARs listed in Feasibility Study Table 4-21C, in a manner similar to USEPA's preferred alternative, NS-4. In Feasibility Study Table 4-23D (Detailed Analysis of Alternative DS-2 Institutional Controls), USEPA determined that institutional controls for deep wetland sediments would not comply with the chemical-specific ARARs in Feasibility Study Table 4-23C. However, Feasibility Study Table 4-23C states that the ARARs will be attained, and that surface water monitoring would be conducted to confirm that sediment contamination that is left in place does not impact surface water, which would also be the case for the Alternative Remedial Action.

Location-Specific ARARs - A subaqueous cap in the HBHA Pond would comply with the location-specific ARARs in Feasibility Study Table 4-15B. *In situ* capping and re-vegetation in Wells G&H and Cranberry Bog Conservation Area wetlands would comply with the pertinent location-specific ARARs listed in Feasibility Study Table 4-21B. The proposed capping and re-vegetation would result in less adverse impacts to the wetland (Federal and State regulatory requirements) caused by the intrusive nature of the excavation activities included as part of the USEPA's preferred alternative, NS-4. Because there are no actions associated with institutional controls for deep wetland sediments, there are no location-specific ARARs identified in the Feasibility Study (Table 4-23B).

Action-Specific ARARs – A subaqueous cap in the HBHA Pond would comply with the action-specific ARARs in Feasibility Study Table 4-15A. *In situ* capping and re-vegetation in Wells G&H and Cranberry Bog Conservation Area wetlands would comply with the pertinent action-specific ARARs listed in Feasibility Study Table 4-21A, in a manner similar to USEPA's preferred alternative, NS-4. Although the Alternative Remedial Action could result in a change in the type of wetland vegetation present (a positive change in terms of habitat diversity), the Alternative Remedial Action is not expected to result in a measurable impact to the flood storage capacity of the wetland. This alternative is expected to comply with action-specific ARARs. In Feasibility Study Table 4-23D (Detailed Analysis of Alternative DS-2 Institutional Controls), USEPA determined that institutional controls for deep wetland sediments would not comply with the action-specific ARARs in Feasibility Study Table 4-23A. This statement contradicts Feasibility Study Table 4-23A that indicates action-specific ARARs will be attained, and that surface water monitoring would be conducted to confirm that sediment contamination that is left in place does not impact surface water, which would also be the case for the Alternative Remedial Action.

Other Criteria, Advisories, and Guidance – A subaqueous cap in the HBHA Pond would comply with appropriate ecological risk-management criteria for HBHA Pond sediment and control migration of arsenic to surface water in the pond. *In situ* capping and re-vegetation in Wells G&H and Cranberry Bog Conservation Area wetlands would comply with appropriate human health risk-management criteria for these wetland sediments as effectively as the USEPA's preferred alternative, NS-4. Institutional controls for deep wetlands sediments would comply with appropriate risk-management criteria.

Surface Water – Monitoring is the preferred alternative for surface water in this Alternative Remedial Action as well as in USEPA's proposed plan. Accordingly, this evaluation of surface water monitoring for compliance with ARARs is consistent with USEPA's Alternative SW-2, Monitoring – Surface Water.

Chemical-specific ARARs – In Feasibility Study Table 4-26D (Detailed Analysis of Alternative SW-2 Monitoring – Surface Water), USEPA determined that surface water monitoring would not comply with the chemical-specific ARARs in Feasibility Study Table 4-26C unless other media-specific alternatives were selected in conjunction with monitoring to address groundwater and sediment contaminant sources. The treatment of groundwater and sediment through the placement of a subaqueous permeable reactive cap in the HBHA Pond will make the chemical-specific ARARs attainable for this alternative.

Location-specific ARARs – Because there are no actions associated with this alternative, no location-specific ARARs were identified in the Feasibility Study (Table 4-26B).

Action-specific ARARs – In Feasibility Study Table 4-26D (Detailed Analysis of Alternative SW-2 Monitoring – Surface Water), USEPA determined that surface water monitoring would not comply with action-specific ARARs in Feasibility Study Table 4-26A unless other media-specific alternatives were selected in conjunction with monitoring to address groundwater and sediment contaminant sources. The treatment of groundwater and sediment through the placement of a subaqueous permeable reactive cap in the HBHA Pond will make the action-specific ARARs attainable for this alternative.

Other Criteria, Advisories, and Guidance – In Feasibility Study Table 4-26D (Detailed Analysis of Alternative SW-2 Monitoring – Surface Water), USEPA determined that surface water monitoring would not comply with appropriate risk-management criteria for protection of benthic communities in the HBHA Pond. As above, monitoring in conjunction with capping will improve deep surface water quality within the HBHA Pond with respect to arsenic, even if baseline conditions causing anoxia continue to constrain the overall benthic habitat quality.

3.2.3 Long-Term Effectiveness and Permanence

Soil – This component of the Alternative Remedial Action is consistent with the USEPA's Proposed Plan. Prohibitions on the use of impacted properties for a day care facility through institutional controls would be maintained in perpetuity. Similarly, prohibitions on excavation without regulatory oversight and adequate health and safety precautions would remain in place to assure long-term effectiveness of institutional controls.

Groundwater – Deed restrictions that would prohibit the use of site groundwater at the West Hide Pile for industrial process water or car wash use would assure long-term effectiveness and permanence.

Sediments in the bottom of the HBHA Pond are effectively removing arsenic from groundwater and there are hundreds of years of remaining sorptive capacity in these sediments. The placement of a reactive cap over the entire sediment bed of the HBHA Pond will increase sorptive capacity because existing sediments and the permeable, subaqueous, reactive cap, would be working in concert to treat arsenic in groundwater, achieving long-term effectiveness. Under current and predictable geochemical conditions, the sorption of arsenic by iron-containing minerals or media in the native sediments and reactive cap are stable and essential not reversible, assuring greater permanence than USEPA's Proposed Plan. Placement of the subaqueous cap would include installation of silt curtains, sedimentation booms, and other equipment to prevent downstream migration of resuspended sediments. A geogrid would be used to minimize sediment resuspension during placement. Residual risks are expected to be less than under USEPA's preferred alternative since the most contaminated materials will remain sequestered at the bottom of the pond.

Sediments – This Alternative Remedial Action, which includes sequestering contaminated sediments within the HBHA Pond beneath a subaqueous permeable reactive cover would be constructed using appropriate engineering controls and would result in less residual risk to benthic invertebrates than USEPA's preferred alternative by virtue of sorbing arsenic within the reactive cap layer. As previously noted, the HBHA Pond was intended and designed as a stormwater detention basin and not as aquatic habitat and would remain limited in habitat quality due to anoxia in the bottom waters resulting from its design; this is also true for USEPA's Proposed Plan. Through the construction of flow control structures and devices in the HBHA Pond and HBHA Wetland, natural deposition would be enhanced, promoting the long-term effectiveness and permanence of arsenic sequestration within the highly stable sediments of the HBHA Pond and Wetland. The design of the flow control structures within the pond and wetland would reduce surface water flows and increase sediment/floc deposition passively, a fail-proof design which adds to the long-term effectiveness and permanence of the remedial action. Construction in the HBHA Pond and Wetland would include appropriate and reliable engineering controls to prevent disturbance of the subaqueous cap (described above). Because the proposed flow controls will promote settling of iron hydroxide floc and any sorbed arsenic that might migrate through the existing sediments and permeable, subaqueous reactive cover, this alternative should result in less residual risk than USEPA's preferred alternative.

The long-term effectiveness and permanence of capping in the Wells G&H Wetland and Cranberry Bog Conservation Area Wetland would be enhanced through the re-vegetation. To verify re-vegetation successfully creates biological barriers, an adaptive management plan would be implemented. The adaptive management plan would provide for planting over three to five years, rather than a single event. This strategy would allow for adjusting the volume and mix of vegetation used to achieve the desired habitat edges, as well as biological barriers.

The proposed alternative would include adequate and reliable controls during construction. Based on comparison of *in situ* capping and dredging/excavation effectiveness at other aquatic sites, capping is expected to pose less risk of re-contamination than dredging/excavation, and the creation of natural biological barriers in capping areas would result in less residual direct contact exposure risk to recreational visitors than USEPA's excavation alternative.

Inaccessibility to sediments in the deep areas of the HBHA and Wells G&H wetlands will be provided through maintaining institutional controls. The residual risk of direct contact exposure resulting from someone wading into deep areas of the wetlands, or future dredgers ignoring the institutional controls guiding construction are remote. In the event of such remote exceptions, direct contact exposure would be expected to be less than the conservative exposure assumptions used in determining the need to avoid exposure to those sediments.

Surface Water – Because of the anticipated effectiveness of groundwater treatment through placement of a subaqueous permeable reactive cap, the residual risk resulting from monitoring without performing any other remedial actions for surface water is expected to be small. Low oxygen concentrations still occur in deep surface water despite effective arsenic removal from groundwater discharging to surface water; this condition may pose the greatest residual risk to benthic invertebrates and fish. No engineering controls are associated with this alternative.

3.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Soil – Consistent with the USEPA's Proposed Plan, institutional controls do not provide any reduction of toxicity, mobility, or volume through treatment.

Groundwater – Institutional controls that would prohibit the use of site groundwater at the West Hide Pile do not provide reduction of toxicity, mobility, or volume through treatment. However, concentrations of benzene are attenuating naturally in the West Hide Pile area, having decreased from 63,000 µg/L in 1991 to 4,800 µg/L in 2002, which is less than the applicable 7,000 µg/L MCP GW-3 surface water protection standard.

The reactive cap will supplement the natural effectiveness of existing sediments in treating groundwater to remove arsenic as it discharges to surface water in the HBHA Pond. Although bench-scale testing would be conducted to determine the most effective iron minerals/materials or combination of amendments to achieve arsenic removal from groundwater, it is expected that nearly all arsenic can be removed from groundwater discharging to surface water in the northern portion of the HBHA Pond. Although the arsenic is not destroyed in this treatment, it is stable, not leachable, and essentially irreversibly bound within the sediments and reactive cap layer under current and reasonably anticipated geochemical conditions. This binding of arsenic within the sediments and reactive cap layer will considerably reduce the toxicity and mobility of arsenic in surface water downstream of the northern portion of the HBHA Pond. This Alternative Remedial Action is consistent with the statutory preference for treatment as a principal remedy element.

Sediments – Although groundwater discharge to surface water is limited to the northern portion of the HBHA Pond, sediments throughout the pond contain arsenic. The placement of the permeable reactive cap over the entire sediment bed will provide treatment for arsenic in sediments equivalent to *in situ* stabilization. However, treatment will only occur for the very limited concentration of arsenic in sediment porewater that, without the cap, would be available for interaction with surface water and subsequent potential release from the existing sediment bed. The reactive cap will irreversibly capture/treat most of that small concentration of dissolved arsenic. Therefore, this alternative is consistent with the statutory preference for treatment.

Capping in the Wells G&H Wetland and the Cranberry Bog Conservation Area, and integrated wetland restoration, would not include treatment of contaminated wetland sediment or dewatering effluent. As such, this Alternative Remedial Action would not reduce toxicity, mobility, and volume of contaminants in the wetlands through treatment. Although the Feasibility Study cites the reduction of toxicity, mobility, and volume through the treatment of 3,000,000 gallons of dewatering effluent, it should be noted that this treatment is necessitated because of the proposed excavation of wetland sediments containing approximately 50% water. *In situ* groundwater within the wetland does not require remediation. Because solids remaining from dewatering operations would likely be disposed of at a landfill, the USEPA's preferred alternative offers no advantage over *in situ* capping under this evaluation criterion.

Consistent with the USEPA's Proposed Plan, institutional controls proposed for preventing direct contact exposure to deep sediments do not provide any reduction of toxicity, mobility or volume through treatment.

Surface Water – Monitoring would not reduce the toxicity, mobility, or volume of contaminants through treatment.

3.2.5 Short-Term Effectiveness

Soil – Institutional controls prohibiting use of the Former Lake Mishawum should not present any short-term impacts or inconvenience to the community or site workers, and there are no impacts associated with construction or implementation. Requirements for adequate precautions (engineering controls, personal protective equipment, etc.) for any excavation in this area should also not present any remedy-related short-term impacts.

Groundwater – Deed restrictions that would prohibit the use of site groundwater at the West Hide Pile for industrial process water or car wash use should not present any short-term impacts or inconvenience to the community or site workers, and there are no impacts associated with construction or implementation.

The placement of a reactive cap over the entire sediment bed of the HBHA Pond will require mobilization and demobilization of required personnel and equipment to the site. However, this Alternative Remedial Action for groundwater should not pose any greater short-term impacts to the community or workers during the construction than the USEPA's preferred alternative involving interception and treatment in the northern portion of the HBHA Pond. Proven reliable measures would be implemented to control sediment resuspension during placement (geogrids or other suitable geosynthetics, silt curtains, sedimentation booms, etc.). Because of the current degraded condition of any potential benthic habitat within the pond, associated with anoxic conditions in the sediments, cover placement would not cause adverse short-term environmental impacts. The remedial action would address groundwater RAOs for the HBHA Pond upon completion of the construction; implementation is expected to take approximately four months.

Sediments – The potential short-term impacts to the community and construction workers, potential short-term environmental impacts, and time until RAOs are achieved for capping in the HBHA Pond are discussed above. The construction of flow control structures and devices in the HBHA Pond and HBHA Wetland would pose considerably fewer short-term impacts to the community than the hydraulic dredging of HBHA Pond sediments proposed in USEPA's Proposed Plan, which involves hazardous material processing on land, then offsite transport for disposal. Similarly, the construction of flow control structures would pose less risk of worker exposure to hazardous materials. Increased sedimentation from the flow control structures should not cause any adverse environmental impacts. The combination of capping and construction of flow control structures will immediately present an improved benthic habitat upon construction completion. However, anoxic conditions will to continue for HBHA Pond sediments under this or USEPA's Proposed Plan, since the pond was designed as a stormwater detention basin rather than aquatic habitat, and its very design is what creates the anoxic conditions.

In situ capping and integrated wetland restoration in the Wells G&H and Cranberry Bog Conservation Area wetlands would pose minimal impacts during construction. The only anticipated impact would be traffic associated with construction vehicle and equipment transportation, transportation of clean capping materials, and workers traveling to and from the site. As with USEPA's preferred alternative, these impacts would be mitigated through traffic control planning. However, because of the need to transport hazardous materials for offsite disposal and to treat dewatering effluent onsite, USEPA's preferred alternative will generate considerably more traffic than the Alternative Remedial Action, and has a greater potential for community impacts should there be any accidental releases of untreated water or solid hazardous wastes during transportation. Under either alternative, construction would be conducted in accordance with all required health and safety regulations and procedures, and appropriate engineering controls. However, removal of contaminated sediment, dewatering and treatment of effluent, and transportation of arsenic-containing sediments to an offsite facility for disposal under USEPA's proposed plan would pose a far greater risk of worker exposure to chemical contamination, and is a more labor intensive project.

Capping and re-vegetation pose some unavoidable impacts to the environment resulting from construction within a wetland. Similar degrees of short-term impact are expected under this Alternative

Remedial Action and USEPA's Proposed Plan. However, because dredging/excavation under USEPA's Proposed Plan, resuspension and downstream transport of arsenic-containing sediments during dredging could expand the spatial area and volume of wetland sediment to be excavated could be expanded, which would increase the potential for short-term impacts resulting from USEPA's Proposed Plan. The Alternative Remedial Action of capping and restoration is expected to require less than four months to implement. However, the adaptive management plan would involve planting vegetation over three to five years, which would be the expected timeframe for the wetlands portion of the remedy to become fully effective.

The institutional controls proposed for the deep wetlands sediments would not pose any potential short-term impacts to the community, construction workers, or the environment.

Surface Water – Monitoring would not cause any short-term impacts to the community or the environment. Because the surface water does not pose a human health risk, there would not be any expected adverse impacts to workers implementing this alternative even though sampling would be done by trained environmental samplers supplied with personal protective equipment.

3.2.6 Implementability

Soil – The proposed institutional controls for the Former Lake Mishawum area could easily be implemented, although would require coordination with local, state, and federal agencies and property owners to develop property-specific deed restriction documents.

Groundwater – Deed restrictions that would prohibit the use of site groundwater at the West Hide Pile for industrial process water or car wash use could easily be implemented. The Custodial Trust owns the property on which the West Hide Pile is located, reducing the need for coordination of deed restrictions.

Sediment capping is an established technology that would be very implementable within the HBHA Pond. The geometry of the pond would facilitate the implementation of engineering controls to minimize sediment resuspension and downstream transport.

Sediments – Implementability of capping within the HBHA Pond was discussed above. The additional construction of a low-head dike at the pond outlet, installation of three more dikes within the HBHA Wetland, and the proposed capping and re-vegetation within the Wells G&H and Cranberry Bog Conservation Area wetlands are also technically implementable. The required construction services and materials for capping and flow controls are available within the site region. The administrative feasibility of the Alternative Remedial Action for sediments will hinge upon the permitting required to perform construction within delineated wetlands, and mitigation of lost wetlands. The Alternative Remedial Action will involve more construction within wetlands, specifically the HBHA Wetland, than USEPA's Proposed Plan, and thus face greater administrative implementability impediments. Institutional controls for deep wetland sediments are readily implementable.

Surface Water – The proposed monitoring would be technically and administratively implementable.

3.2.7 Cost

The estimated costs for this Alternative Remedial Action are summarized below.

Media	Location	Alternative Remedial Action	Cost
Surface and Subsurface Soil	Former Lake Mishawum	Institutional controls to restrict access to surface and subsurface soils and periodic inspections	$1.4MM
		Long-term groundwater monitoring	$0.1MM
Groundwater	Halls Brook Holding Area Pond	Permeable subaqueous reactive cover over existing sediments in the bottom of HBHA Pond to sorb arsenic as groundwater discharges to surface water	$3.0MM
		Long-term groundwater monitoring	$0.9MM
	West Hide Pile	Site-wide institutional controls to restrict groundwater use	$0.2MM
Sediments	Halls Brook Holding Area Pond	Flow controls to increase sediment deposition	$0.5MM
		Long-term sediment monitoring	$0.3MM
	Halls Brook Holding Area Wetland	Flow controls to increase sediment deposition	$4.3MM
		Institutional controls to restrict access to sediments and periodic inspections	$0.4MM
	Wells G&H Wetland and Cranberry Bog Conservation Area	In-situ capping to prevent exposure to near-shore	$0.6MM
		Biological barriers (thorn bushes) to limit access to deep water sediments	$0.3MM
	Wells G&H Wetland - Deep Areas	Institutional controls to restrict access to deep water sediments and periodic inspections	$0.4MM
Surface Water	Halls Brook Holding Area	Long-term surface-water monitoring	$1.5MM
		TOTAL ESTIMATED 30-YEAR NPV COST (7% DISCOUNT)	$13.9MM

4.0 Comparative Analysis of Alternative Remedial Action and USEPA's Proposed Plan

In this section, the Alternative Remedial Action and USEPA's Proposed Plan are compared to one another to identify the relative advantages and disadvantages of each potential remedial action. A forced ranking system was used to identify the alternative that best achieves the requirements of the seven NCP evaluation criteria used to evaluate remedial alternatives. In this forced ranking system, the alternative that best meets the requirements of a criterion was awarded a score of 1 and the second best alternative was awarded a score of 2. Using this ranking method, the alternative with the lowest score is the one that best meets the requirements of the seven criteria. This comparative analysis is summarized below:

Forced-Ranking Comparison of Alternative Remedial Action and USEPA's Proposed Plan

Evaluation Criterion	Alternative Remedial Action	USEPA's Proposed Plan
Overall Protection of Human Health and the Environment	1	2
Compliance with ARARs	1	2
Long-Term Effectiveness and Permanence	1	2
Reduction of Toxicity, Mobility or Volume through Treatment	1	2
Short-Term Effectiveness	1	2
Implementability	1	2
Cost	1	2
TOTAL SCORE	7	14

The following sections compare this Alternative Remedial Action with USEPA's Proposed Plan according to each evaluation criterion. The alternatives corresponding to each medium (soil, groundwater, sediments, surface water) are compared and scored using the forced ranking system described above. Identical alternatives, such as surface water monitoring, and institutional controls for surface and subsurface soils in the former Mishawum Lake bed and deep wetland sediments, are scored as 1. The combination of alternatives with the lowest total score is ranked best (1) in the above summary.

4.1 Overall Protection of Human Health and the Environment

While not necessary to achieve the RAOs, USEPA's Proposed Pplan includes *in situ* bioremediation of groundwater at the West Hide Pile. Although bioremediation would generally be considered to provide greater overall protection of human health and the environment than institutional controls, the *in situ* bioremediation as described in USEPA's Proposed Plan will not achieve greater reduction of benzene concentrations than ongoing natural attenuation. Therefore, the institutional controls proposed as part of the Alternative Remedial Action are considered to provide comparable overall protection of human health and the environment. The Alternative Remedial Action proposed for groundwater in the HBHA Pond would more effectively treat groundwater entering the HBHA Pond and discharging to surface water than USEPA's Proposed Plan. Capping sediments in the HBHA Pond and the Wells G&H and Cranberry Bog Conservation Area wetlands would provide greater overall protection of human health and the environment than hydraulic dredging of HBHA Pond sediments and excavation and offsite disposal of near-shore wetland sediments. In total, the Alternative Remedial Action provides greater overall protection of human health and the environment, as summarized below.

Forced-Ranking – Overall Protection of Human Health and the Environment

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	1
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	12

4.2 Compliance with ARARs

The *in situ* bioremediation as described in USEPA's Proposed Plan will not achieve greater reduction of benzene concentrations than ongoing natural attenuation. Therefore, the institutional controls proposed as part of the Alternative Remedial Action are considered to provide comparable compliance with ARARs. The Alternative Remedial Action proposed for groundwater in the HBHA Pond would more effectively treat groundwater entering the HBHA Pond and discharging to surface water than USEPA's Proposed Plan, thereby providing greater assurance of compliance with appropriate risk-management criteria for arsenic in deep surface water than USEPA's Proposed Plan. While the Alternative Remedial Action would include filling a one-acre area to construct the caps at the Wells G&H Wetland and the Cranberry Bog Conservation Area, this would be more than offset by wetland areas constructed on the surface of the caps. These caps would be vegetated to create a scrub-scrub wetland that would increase the functions and values of wetlands in the Wells G&H and Cranberry Bog Conservation Area through increased diversity. As a result, mitigation for constructing the caps is not be required as the functions and values of the wetland area are being increased and the wetland areas are not being lost. The function and values of the wetlands areas are further increased under the Alternative Remedial Action by constructing a new acre of benthic habitat and enhancing an additional 2.15 acres in the HBHA Wetland. Thus, the Alternative Remedial Action ranks better than the USEPA's Proposed Plan for compliance with location-specific and action-specific ARARs. In total, the Alternative Remedial Action would provide greater compliance with ARARs than USEPA's Proposed Plan, as summarized below.

Forced-Ranking – Compliance with ARARs

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1

Groundwater – West Hide Pile	1	1
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	12

4.3 Long-Term Effectiveness

The *in situ* bioremediation as described in USEPA's Proposed Plan will not achieve greater reduction of benzene concentrations than ongoing natural attenuation. Therefore, the institutional controls proposed as part of the Alternative Remedial Action are considered to provide comparable long-term effectiveness. The Alternative Remedial Action proposed for groundwater in the HBHA Pond would more effectively and irreversibly treat groundwater entering the HBHA Pond and discharging to surface water than USEPA's Proposed Plan. Enhancing sedimentation in the HBHA Wetland through construction of low-head dikes would provide greater long-term effectiveness and less residual risk than the institutional controls proposed by USEPA. Capping sediments in the HBHA Pond and the Wells G&H and Cranberry Bog Conservation Area wetlands would provide greater long-term effectiveness with reliable controls and less residual risk than USEPA's Proposed Plan. In total, the Alternative Remedial Action provides greater long-term effectiveness, as summarized below.

Forced-Ranking – Long-Term Effectiveness

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	1
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	12

4.4 Reduction of Toxicity, Mobility or Volume Through Treatment

USEPA's Proposed Plan for *in situ* bioremediation of groundwater at the West Hide Pile will not provide any greater reduction of benzene toxicity, mobility or volume through treatment than ongoing natural attenuation processes. As a result, the institutional controls proposed as part of the Alternative Remedial Action, which do not include "treatment" per se, are considered comparable to USEPA's preferred alternative under this evaluation criterion. The subaqueous permeable reactive cap proposed for treating groundwater in the HBHA Pond would more effectively reduce the toxicity, mobility and volume of arsenic in groundwater entering the HBHA Pond and discharging to surface water than USEPA's Proposed Plan. The capping of HBHA Pond sediments would also more effectively reduce the mobility of arsenic in sediments through treatment than USEPA's proposed hydraulic dredging. Enhancing sedimentation in the HBHA Wetland through construction of low-head dikes would reduce the mobility of arsenic in sediments through burial of existing sediments by increasingly cleaner suspended particles. Specifically, the reactive cap would reduce release of arsenic into HBHA Pond surface water, where it can co-precipitate on iron hydroxide floc and suspended sediments entering and flowing through the HBHA Pond. Capping sediments in the HBHA Pond and the Wells G&H and Cranberry Bog Conservation Area wetlands would not constitute treatment. Conversely, potential stabilization of dewatered sediments hydraulically dredged from the HBHA Pond and excavated from near-shore wetlands areas would provide some reduction of mobility through treatment. In total, the Alternative Remedial Action would provide greater reduction of toxicity, mobility or volume through treatment, as summarized below.

Forced-Ranking – Reduction of Toxicity, Mobility or Volume Through Treatment

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	1
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	2	1
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	9	11

4.5 Short-Term Effectiveness

This Alternative Remedial Action provides better short-term effectiveness, with fewer impacts to the community and construction workers, than USEPA's Proposed Plan. With the exception of the three- to five-year adaptive management plan for creating natural biological barriers over near-shore wetlands capping areas, the Alternative Remedial Action would achieve RAOs in less time than USEPA's Proposed Plan. In total, the Alternative Remedial Action would provide greater short-term effectiveness, as summarized below.

Forced-Ranking – Short-Term Effectiveness

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	2
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	1	2
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	13

4.6 Implementability

USEPA's Proposed Plan for HBHA Wetland sediments, institutional controls, would be more implementable than the Alternative Remedial Action, construction of flow control structures to enhance sedimentation. Because of the permitting necessary for any construction in wetlands that might impair wetlands habitat or create net loss of wetlands, despite an overall enhancement of riparian wetland habitat diversity, the administrative feasibility of the Alternative Remedial Action for near-shore sediments within the Wells G&H and Cranberry Bog Conservation Area wetlands and USEPA's preferred alternative are considered comparable. In total, the Alternative Remedial Action would be more implementable, as summarized below.

Forced-Ranking – Implementability

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	2
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	2	1
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	1
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	1
TOTAL SCORE	8	11

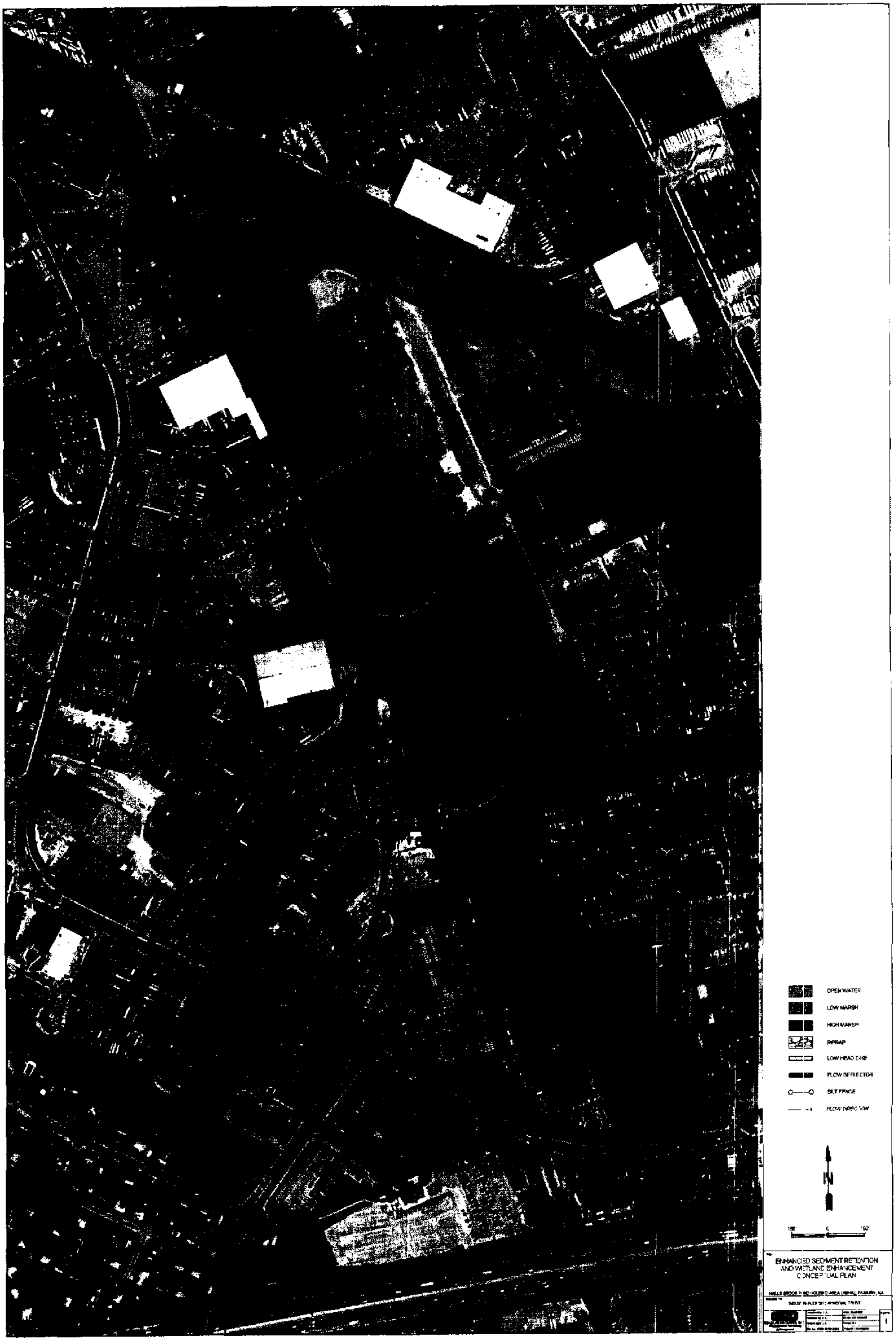
4.7 Cost

USEPA's proposed institutional controls for the HBHA Wetland sediments would cost less to implement than the construction of flow controls described in the Alternative Remedial Action. In total, the Alternative Remedial Action would achieve greater protection of human health and the environment at less cost than USEPA's Proposed Plan.

Forced-Ranking – Cost

Medium	Alternative Remedial Action	USEPA's Proposed Plan
Surface and Subsurface Soil – Former Mishawum Lake	1	1
Groundwater – West Hide Pile	1	2
Groundwater – HBHA Pond	1	2
Sediments – HBHA Pond	1	2
Sediments – HBHA Wetland	2	1
Sediments – Near-Shore Wells G&H and Cranberry Bog Wetlands	1	2
Sediments – Wells G&H Wetland - Deep Areas	1	1
Surface Water – HBHA and Aberjona River	1	2
TOTAL SCORE	9	13

Alternative Remedial Action Plan Figure 1



Alternative Remedial Action Plan Figure 2

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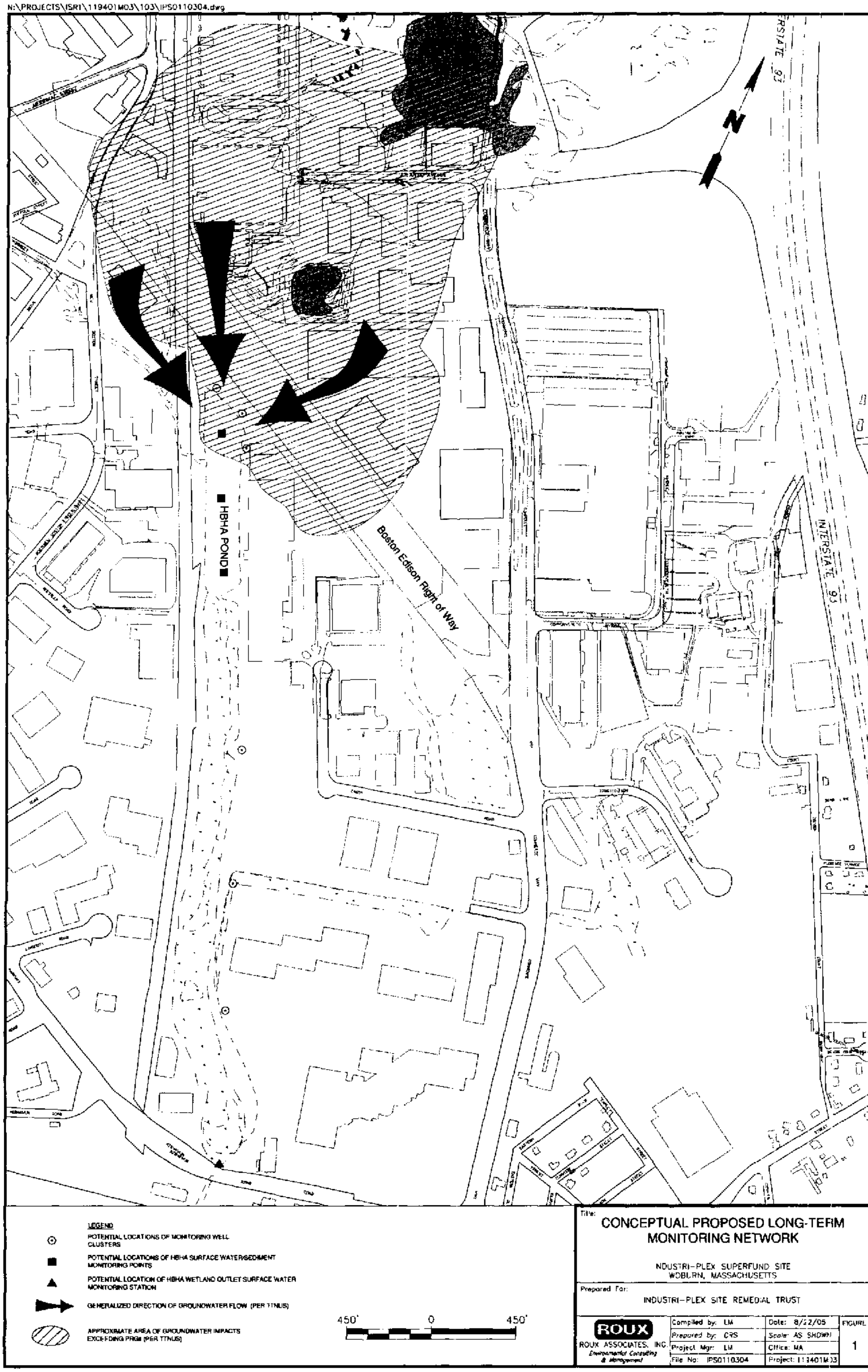

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T. J. Casey
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Joseph F. LeMay
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08/31/2005 05:12 PM

To Joe Lemay/R1/USEPA/US@EPA

cc

bcc

Subject Stauffer Management Company's Comments to EPA's RI, FS, and Proposed Plan for Industri-Plex Site

Mr. LeMay:

Attached are Stauffer Management Company's comments to EPA's RI, FS, and Proposed Plan for the Industri-Plex Site. Also attached is a cover letter to Stauffer's comments, which indicate that additional submissions are to be included with Stauffer's comments.

We attempted to deliver by hand a hard copy of all of these submissions to your office after 4pm today, but were told that no one would claim them. We trust and hope that this logistical difficulty will not prevent Stauffer's submission, in its entirety, from becoming part of the Record of Decision for the Site.

Please let me know if you have any questions, or if there is anything further I can do to facilitate delivery of the materials to be submitted by Stauffer to your office.

Thank you for your consideration in this matter,

Tim Casey

<<SMC Comments to EPA RI, FS, and Proposed Plan.pdf>> <<Letter to Joe LeMay.pdf>>

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Email: tcasey@ropesgray.com SMC Comments to EPA RI, FS, and Proposed Plan.pdf Letter to Joe LeMay.pdf

"Casey, Timothy J."
<Timothy.Casey@ropesgray.com>
08/31/2005 05:28 PM

To Joe Lemay/R1/USEPA/US@EPA
cc
bcc
Subject Stauffer Management Company's Combined "Comments on USEPA's June 2005 Proposed Plan

Mr. LeMay:

Attached are the Combined "Comments on USEPA's June 2005 Proposed Plan," with tables and figures, which are identified in the cover letter to Stauffer Management Company's comments, which I emailed to you a few minutes ago. Please let me know if you have questions.

Thanks,

Tim Casey

<<Comments on USEPA's June 2005 Proposed Plan.pdf>> <<Combined Comments Table 1.pdf>> <<Combined Comments Figure 1.pdf>> <<Combined Comments Figure 2.pdf>> <<Combined Comments Figure 3.pdf>> <<Combined Comments Figure 4.pdf>> <<Combined Comments Figure 5.pdf>> <<Combined Comments Attachment.pdf>>

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Comments on USEPA's June 2005 Proposed Plan.pdf Combined Comments Table 1.pdf
Combined Comments Figure 1.pdf Combined Comments Figure 2.pdf Combined Comments Figure 3.pdf
Combined Comments Figure 4.pdf Combined Comments Figure 5.pdf Combined Comments Attachment.pdf

"Casey, Timothy J."
<Timothy.Casey@ropesgray.com>

08/31/2005 05:30 PM

To Joe Lemay/R1/USEPA/US@EPA

cc

bcc

Subject Stauffer's Alternative Remedial Plan

Mr. LeMay,

Attached is an "Alternative Remedial Action Plan" for the Industri-Plex Site, with figures, which is identified in my cover letter to Stauffer Management Company LLC's comments to EPA's RI, FS, and Proposed Plan for the Site.

Please let me know if you have any questions.

Tim Casey

<<Alternative Remedial Action Plan.pdf>> <<Alternative Remedial Action Plan Figure 1.pdf>>
<<Alternative Remedial Action Plan figure 2.pdf>>

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Alternative Remedial Action Plan.pdf Alternative Remedial Action Plan Figure 1.pdf

Alternative Remedial Action Plan figure 2.pdf

"Casey, Timothy J."
<Timothy.Casey@ropesgray.com>
08/31/2005 05:36 PM

To Joe Lemay/R1/USEPA/US@EPA
cc
bcc
Subject Stauffer's Submissions from Gradient Corp. re: EPA RI, FS, and Proposed Plan

Mr. LeMay:

Apologies for the deluge of email. Here is the final email, which includes a letter from Barbara Beck of Gradient Corp. to you, dated August 29, 2005, as well as Gradient Corp.'s comments on EPA's Baseline Human Health Risk Assessment, dated October 13, 2003. These submissions are identified in the cover letter I sent you minutes ago for Stauffer Management Company LLC's comments to EPA's RI, FS, and Proposed Plan for the Industri-Plex Site.

Please do not hestitate to contact me if you have questions regarding these materials, or if there is anything further I can do to make these documents accessible to you and your office. Tomorrow I will re-send the hard copies of all of these documents, which I attempted to send by hand to your office shortly after 4pm today.

Best regards,

Tim Casey

<<Gradient Comment Letter.pdf>> <<Gradient Comments to Baseline Human Health Risk Assessment.pdf>>

Timothy J. Casey
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Email: tcasey@ropesgray.com Gradient Comment Letter.pdf Gradient Comments to Baseline Human Health Risk Assessment.pdf

"Casey, Timothy J."
<Timothy.Casey@ropesgray.com>

08/31/2005 05:36 PM

To Joe Lemay/R1/USEPA/US@EPA

cc

bcc

Subject Stauffer's Submissions from Gradient Corp. re: EPA RI, FS, and Proposed Plan

Mr. LeMay:

Apologies for the deluge of email. Here is the final email, which includes a letter from Barbara Beck of Gradient Corp. to you, dated August 29, 2005, as well as Gradient Corp.'s comments on EPA's Baseline Human Health Risk Assessment, dated October 13, 2003. These submissions are identified in the cover letter I sent you minutes ago for Stauffer Management Company LLC's comments to EPA's RI, FS, and Proposed Plan for the Industri-Plex Site.

Please do not hestitate to contact me if you have questions regarding these materials, or if there is anything further I can do to make these documents accessible to you and your office. Tomorrow I will re-send the hard copies of all of these documents, which I attempted to send by hand to your office shortly after 4pm today.

Best regards,

Tim Casey

<<Gradient Comment Letter.pdf>> <<Gradient Comments to Baseline Human Health Risk Assessment.pdf>>

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Gradient Comment Letter.pdf Gradient Comments to Baseline Human Health Risk Assessment.pdf

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SDMS DocID 237508

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KERRY HEALEY
Lieutenant Governor

ELLEN ROY HERZFELDER
Secretary

ROBERT W. GOLLEDGE, Jr.
Commissioner

August 31, 2005

Industri-Plex
4.1
237508

Joe LeMay
USEPA - New England, Region 1
1 Congress Street, Suite 1100
HBO
Boston, MA 02114-2023

Subject: DEP Comments on the Feasibility Study and the Proposed Plan for Industri-Plex Operable Unit 2, Woburn, MA.

Dear Joe,

DEP has completed review of the June 2005 Draft Final Feasibility Study prepared by TetraTechNUS and the June 2005 Proposed Plan prepared by EPA for the Industri-Plex Superfund Site located in Woburn, MA under Operable Unit (OU) 2. Separate specific comments on the documents are attached. These comments override any prior comments made on these documents.

DEP has already reviewed and commented on the internal draft of the FS, withholding comment on the ARAR sections until after EPA internal review was complete. Therefore, the primary focus of our FS comments is on the ARAR review. If you have any questions concerning the attached comments, please contact me. Thank you.

Sincerely,

Anna Hyatt Mayor
Project Manager, Federal Superfund Section
BWSC, Boston

cc. Andy Cohen, DEP OGC
Jay Naparstek, DEP BWSC
Paul Craffey, DEP BWSC
Dave Buckley, DEP BWSC

Comments: Draft Final Feasibility Study

1. Pg. 78, Section 2.1.4: a. This section cites the MADEP Method 1 standards as "to be considered", then states that the standards are relevant. The standards should solely be cited as "to be considered" because the standards are not applied at every site (just those that choose to use Method 1). In addition, the section states that the soil categories are "established based on a site-specific risk/exposure analysis". Since the soil categories are already established and are only selected by the environmental professional for use after evaluating their site-specific exposure scenario, it would be more accurate to state the following: "...the category of standards used are selected based on a site-specific risk and exposure analysis."

b. DEP would prefer that the term "concur" not be used in the section with reference to the findings of the risk assessment primarily because DEP has a formal concurrence process in relation with the ROD that has not yet occurred. DEP has evaluated the federal and the state risk assessment methodologies and views the EPA risk assessment procedures as equivalent to those that are conducted under the MCP (Method 3), and we in this case consider the remedial goals developed from that process adequate.

c. DEP recommends that the last sentence in this section which refers to institutional controls be moved to another section because arguing the reasonableness of one of the remedial alternatives seems out of place within the ARARs section.

2. Table 2-1: a. DEP requests specifically listing 314 CMR 3.00 – the Surface Water Discharge Permit Program as a Chemical-Specific and an Action-Specific State ARAR because there may be instances where discharge to surface water may be necessary during the sediment remedy (right now it is only mentioned for consideration under the listing for their Federal NPDES program).

b. DEP recommends removing the MCP Method 1 Groundwater Standards from the State Regulatory Requirements section and placing it instead in the Criteria, Advisories, and Guidance section as a To Be Considered. In addition, the listing is a little confusing as the requirement column only lists the Groundwater Standards, whereas the Consideration for FS column states that the standards will be considered for developing both soil and groundwater PRGs. The Method 1 Standards are only required at state sites that choose to conduct a Method 1-type risk assessment (not for Method 3 risk assessments which are roughly equivalent to the EPA risk method), therefore the standards are not used consistently at all sites. However, EPA is of course free to consider and use these numbers at any time during the Superfund process.

3. Table 2-3: DEP requests listing 310 CMR 19.000 – Solid Waste Management as an Action-Specific ARAR because some of the remedy involves the capping of sediment and the surrounding banks, therefore some of the landfill capping requirements may be relevant and appropriate.

Comments: Proposed Plan

I. General—
Institutional Controls: DEP supports institutional controls (ICs) in concept for the areas outlined in the Proposed Plan because of the future risk these areas present. However, it has not been possible for DEP to fully evaluate the proposed ICs because EPA did not identify the types of ICs with sufficient specificity, nor compare and contrast the efficacy of different types of ICs in *the feasibility study (FS). In addition, the FS did not appropriately assess the timing or who will* be responsible for securing, maintaining and enforcing the ICs (for example, in the FS Table 4-2D that evaluates ICs for surface soils under the 9 criteria, a time frame is not estimated, and it is incorrectly stated that no coordination among agencies will be required). If these issues are not addressed prior to the ROD, the ROD should then not be limited to a particular type of IC (such as a Grant).

In review of the IC issues for the proposed plan, DEP referred in part to EPA's final fact sheet titled Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups" EPA 540-F-00-005, OSWER 9355.0-74FS-P dated September 2000 which specifically addresses all the issues mentioned.

II. Sediment Remedy--

1. Dredging the HBHA: DEP supports the proposed dredging of the HBHA. Instead of only dredging the southern portion of the HBHA however, DEP recommends dredging the entire pond including the proposed groundwater treatment area prior to installing the cofferdam. Dredging the entire pond would immediately increase the remedial capacity of the northern section of the pond, potentially ensure that Responsible Party funds would be used to do the dredging, and extend the time period that will be needed before the next dredging will have to take place.
2. Since the decision to place ICs for future dredging on a portion of the HBHA wetland was based on the assessment of a single core, DEP recommends leaving flexibility in the remedy decision for further investigation of that area that may reveal that an alternative remedy (e.g., excavation rather than ICs) may be a better option.
3. DEP also questions the need for a cap along the northern bank of the HBHA (which will need long term maintenance, inspections and possibly institutional controls—see Figure 4-3 of the Proposed Plan). Since the bank do not pose an ecological or human health risk, why not continue to let any soil that dislodges from this area end up in the northern treatment area and settle out? This sediment will eventually be dredged along with the accumulated groundwater treatment sediment in the northern section of the HBHA anyway. If EPA believes that this sediment won't settle within the northern basin and will instead pose a risk by suspending and washing downstream during storm events, then

DEP recommends dredging that northern bank along with the sediment of the HBHA in the initial dredging operation.

4. DEP recommends that EPA alter the plan for capping of the New Boston Street Drainway to reduce the need for maintenance and possible ICs. The benefits of the capping are not sufficiently substantiated. For example, if the groundwater is prevented from entering the NBSD (which is the purpose of the impermeable cap) there is not an evaluation as to the alternative endpoint of that groundwater. DEP requests that the NBSD not be capped, and instead culvert the NBSD to confluence with the Atlantic Ave Drainway, the northern treatment area of the HBHA, or the aeration section between the coffer dams. This will ensure that the flow from the NBSD will end up in the treatment area of the HBHA. The Remedial Investigation concluded that most of the increased flow into the HBHA during storm events is from Hall's Brook, so presumably the diversion will not upset the chemocline in the northern section of the HBHA.

III. Groundwater Remedy—
There will be ICs for groundwater established under the first Operable Unit (OU1) for Industri-Plex that will cover most of the groundwater remedial area indicated in the OU2 Proposed Plan. Only a few properties will be in need of an additional groundwater restriction under OU2. Because groundwater is mobile, and restrictions on groundwater should be temporary measures, DEP strongly urges a full evaluation of alternatives to a Grant of Environmental Restriction for those few properties involved (see General comment).

IV. Surface Soil Remedy—
The Feasibility Study does not evaluate a remedy for the soil that would involve partial excavation of the soil in the Mishawum lakebed area; rather EPA chose only to excavate everything, or put ICs on all properties. DEP urges EPA to evaluate the potential benefit of excavating a portion of the contaminated surface soil. DEP thought the following two alternatives would increase protectiveness immediately, and eliminate the need for ICs on several properties:

1. excavate and remove surface soil on only vacant properties,
2. excavate and remove surface soil in the area indicated in the plan, excluding the sub-surface contaminated area. Subsequently, place ICs only on the subsurface contaminated soil area.

V. Surface Water--

1. The DEP notes that an aerator will be a component of the groundwater/surface water remedy south of the upper cofferdam. Apparently the aerator is needed to increase oxygen levels and increase the precipitation of arsenic. This is potentially a part of the remedy requiring frequent maintenance. Therefore, the DEP recommends a method of aeration requiring the lowest-maintenance possible, and enough flexibility in design to allow for the use of a non-polluting energy source for the aerator (e.g., solar panels).
2. In addition, DEP has learned from EPA that elevated ammonia levels have been detected in the site groundwater and surface water, and that the aerator is also intended to reduce

the levels of ammonia in the surface water. This type of treatment is commonly used for this contaminant and will probably be effective; however, at this time, DEP does not have sufficient information concerning the source(s) of the ammonia, the degree of risk posed, and the anticipated target cleanup level to fully evaluate if this is the optimum remedy for ammonia.

A. MAYOR
Bureau of Waste Site Cleanup
Mass. Dept. of Environmental Protection
1 Winter St., 7th FLOOR
Boston, MA 02108

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Joe LeMay
USEPA - New England, Region 1
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Boston, MA 02114-2023

"Mayor, Anna (DEP)" <Anna.Mayor@state.ma.us>

08/31/2005 06:39 PM

To Joe Lemay/R1/USEPA/US@EPA

cc "Buckley, David (DEP)" <David.Buckley@state.ma.us>, "Naparstek, Jay (DEP)" <Jay.Naparstek@state.ma.us>, "Cohen, Andy (DEP)" <Andy.Cohen@state.ma.us>

bcc

Subject Comments on the Iplex OU2 FS/Proposed Plan

Hello Joe. Attached are the DEP's comments on the Industri-Plex site OU2 FS and Proposed Plan. I will also send a hardcopy of the comments through regular mail. If you have any questions, please don't hesitate to call or email me. Thanks,
Anna

Anna Hyatt Mayor
DEP Project Manager, Federal Superfund Section
1 Winter Street, 7th Floor
Boston, MA 02108
Tel. 617-556-1112
Fax 617-292-5530

DEP_Comments_on_FS_and_PP.doc

Woburn City Council
City Hall
10 Common Street
Woburn, MA 01801

September 6, 2005

Joseph F. LeMay
U.S. Environmental Protection Agency
One Congress Street
Suite 1100 (HBO)
Boston, MA 02114
Lemay.Joe@epamail.epa.gov
Fax: (617) 918-1291

Re: Comments about the Proposed Cleanup Plan for the Industri-plex Superfund Site, Woburn, MA (Operable Unit 2 and Wells G & H Operable Unit 3) (the "Draft Feasibility Study" or "Proposed Plan")

Dear Mr. LeMay,

The Woburn City Council cannot endorse EPA's preferred Clean-up Plan for the Industri-plex Superfund Site, Woburn, MA (Operable Unit 2 and Wells G & H Operable Unit 3).

The EPA Region 1 Administration has failed to grant the City of Woburn adequate time and technical resources to review and comment on the Proposed Plan. The City Council is particularly disappointed by EPA's response to its July 21, 2005 request for additional time. In her August 5, 2005 letter to the Woburn City Council, Susan Studlien, Office of Site Remediation and Restoration, implied that EPA had, in its discretion, granted the 30-day extension to date. Ms. Studlien's letter states that, "In furtherance of EPA's commitment to public participation at the Industri-plex superfund site, we have considered previous requests to extend the comment period on the Proposed Plan, and extended the comment period an additional 30 days, for a total of 60 days." We understand that, under the National Contingency Plan (NCP), the EPA is, in fact, obligated to extend the 30-day public comment period by an additional 30 days, upon timely request. Therefore, notwithstanding the numerous timely requests for further extensions, it appears that the EPA Region 1 Administration, in its discretion, has elected to deny all of Woburn's repeated requests for extension beyond what Woburn would otherwise be entitled to under existing EPA policy. The EPA should not be surprised to learn that the City of Woburn questions the sincerity of "EPA's commitment to public participation".

Furthermore, EPA has offered no credible explanation for denying a further extension. According to EPA's own guidance, it should, "Avoid sending the message that a decision has already been reached; this is how the majority of citizens view EPA's proposed plan."[1] Regrettably, by denying the City and community the time needed to review and comment on the Proposed Clean-up Plan and/or granting nothing more than the minimum time extension required by rules and policy, EPA appears to be sending precisely that message. If EPA proceeds to enter a Record of Decision (ROD) based on the Draft Feasibility Study and Proposed Plan, the City of Woburn will be fully justified in believing that the EPA gives no credence and places no value on whether the City supports and/or accepts the Proposed Plan. In fact, we question whether EPA has sufficient information to proceed to ROD, since one of the nine evaluating criteria "Community Acceptance," and, under the circumstances, EPA must either conclude that community acceptance is denied or that it lacks the information to make a meaningful analysis of the alternatives.

Additionally, the Woburn City Council requested on July 21, 2005 that the Draft Feasibility Study and Proposed Plan be subjected to an independent, scientific peer review. It is clear that the Proposed Plan establishes a significant precedent, model and methodological innovations, addresses significant controversial issues, and involves significant investment of Agency resources. Our request for peer review was not addressed in the August 5, 2005 letter from Ms. Studlien nor any other correspondence. In a letter dated July 30, 2002 the EPA assured the Woburn City Council that a peer review process would be available should it be warranted, in addition to the technical assistance offered through the TOSC program. We are dismayed that our most recent request apparently has not been considered by the administration.

After consultation with TOSC scientists about the Draft Feasibility Study and Proposed Plan, the Council continues to have a number of significant and fundamental questions that remain unanswered and hinder our ability to evaluate the proposal. For example:

- EPA has not fully explained whether or not there are current/ongoing releases of COC'S into the Aberjona Watershed, particularly from points north, and if so, does the plan attempt to arrest the migration of such contaminants? Our understanding of the plan is that it principally reduces exposure to COC's and does not necessarily stop migration of COC's at the source or sources.

- EPA makes repeated references to Institutional Controls and we understand that they will be used for Industri-plex. However, the City has never been included in the EPA's discussions and communications about these Institutional Controls, nor has the EPA taken the time to explain what, according to TOSC, will be complex land use restrictions that will necessarily involve local government. When will EPA be explaining these to us? Who will be responsible for regulating,

[1] See page 2 of EPA document entitled, "Public Comment Periods," last updated September 2002.

maintaining, and enforcing such controls for decades to come? What will the associated costs be? Who will bear the costs?

- Could any of the Preferred Alternatives, such as pond or plume intercept methods, inadvertently increase health risks by altering the migration of COC's onto currently "clean" properties within the City? Could any of the Preferred Alternatives, such as the HBHA pond dredging and cofferdams actually interfere with the natural attenuation process that is currently occurring within the sediments of the pond and increase the downstream migration of contaminants?

- We understand that the pond or plume intercept methods, dredging, or storm water bypass methods will significantly reduce the storm water capacity in the area. Will that change create flood storage issues, particularly in an area where periodic flooding from the Aberjona River has been significant concern and the subject of much study and mitigation?

- What are the specific proposed dredging methods and guidelines? Do we have assurances that the most careful methods of removing chemicals have been selected?

- Has there been or will there be any on-site study of the effectiveness of the proposed bioremediation for groundwater before full-scale treatment begins?

- How frequently will clean-up methods be re-evaluated? How frequently and in what format will EPA communicate with the public and public officials about the efficacy of the methods?

Given the history of both of the superfund sites involved in this clean up it is hard to imagine a more controversial superfund site and/or proposed remedial action less deserving of additional time and resources for review. Since EPA, the City and the community have been actively involved in these two sites for decades, one can only assume that poor planning is the reason that EPA is unable to accommodate the City's requests. If indeed that is the case, and/or the suggestion by Ms. Studlien that such an extension would not be consistent with other New England sites, the City finds these explanations wholly inadequate, unsatisfactory and unacceptable.

Ultimately the Woburn City Council needs a better understanding about the preferred alternatives to ensure our constituents and other stakeholders that the Proposed Plan best protects the interests of the City of Woburn and adequately addresses human health and ecological risks now and years to come. The City Council must have confidence that the Proposed Plan will work.

Unfortunately, without the necessary time and resources to review the Draft Feasibility Study and Proposed Plan, the Woburn City Council, as well as the advisors from TOSC are unable to reach that basic conclusion. Therefore, the Woburn City Council cannot grant acceptance of the Draft Feasibility Study and/or Proposed Plan submitted by EPA on June 30, 2005.

Sincerely,
WOBURN CITY COUNCIL

Paul A. Medeiros, President	Paul J. Denaro, ~~Alderman At Large~~
Joanna Gonsalves, Alderman At Large	Charles E. Doherty, Alderman Ward 1
James E. McSweeney, Alderman Ward 2	Scott D. Galvin, Alderman Ward 3
William N. Booker, Alderman Ward 4	John A. Ciriello, Alderman Ward 6
Thomas L. McLaughlin, Alderman Ward 7	

Confirming comments executed, faxed and emailed by President Paul A. Medeiros on August 31, 2005

cc: The Honorable Edward Kennedy, US Senate
The Honorable John Kerry, US Senate
The Honorable Edward Markey, US House of Representatives
The Honorable Robert Havern, Mass. State Senate
The Honorable Patrick Natale, Mass House of Representative
The Honorable Jay R. Kaufman, Mass House of Representative
Mayor John C. Curran
EPA Regional Administrator, Robert W. Varney
Anna Mayor, DEP Superfund Project Manger
Michael & Linda Raymond, Aberjona Study Coalition, Inc.

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Paul Medeiros
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08/31/2005 10:42 PM

To Joe Lemay/R1/USEPA/US@EPA
cc William Campbell <WCampbell@cityofwoburn.com>
bcc
Subject Woburn City Council Comments

History: This message has been forwarded.

Joe
Please accept the attached document as the Woburn City Councils comments about the Proposed Cleanup Plan for the Industri-plex Superfund Site, Woburn, MA (Operable Unit 2 and Wells G & H Operable Unit 3) (the "Draft Feasibility Study" or "Proposed Plan"). I will fax over a copy as well.
Thanks

Paul A. Medeiros
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